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Using Ground Penetrating Radar, Light Detection and Ranging, geodetic leveling, and area hydrogeology to study the Baton Rouge and Scotlandville Faults, East Baton Rouge Parish, LA

Angela Mooi Thomas
Louisiana State University and Agricultural and Mechanical College

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ABSTRACT

East Baton Rouge Parish, Louisiana, is situated on at least two faults, the Baton Rouge Fault and the Denham Springs-Scotlandville Fault. These faults have surface expressions in the form of escarpments and damage to man-made structures. The purpose of this thesis is to study these faults in the shallow subsurface, in climate and soils found in Louisiana, and to study their ability to block fluid flow and whether groundwater withdrawal influences the amount and rate of subsidence along these faults. Techniques used to gather field data or to research and compile previously acquired data for this thesis includes: Ground Penetrating Radar (GPR), measuring displacement using a laser level, Light Detection and Ranging (LIDAR), geodetic leveling, and hydrogeology.

Both faults were determined not to be a single plane, but rather a complex zone of parallel and antithetic faults that are observed over an approximate width of 23 m. Two to three inches of vertical movement has occurred along the fault zone since 1960. GPR data was able to image the shallow normal faulting. However, GPR data did not extend deep enough to determine if they are growth faults.

The LIDAR data and geodetic leveling data shows vertical elevations higher on the northern fault blocks versus the southern fault blocks, and elevations near the Scotlandville fault (Site 2) were higher than near the Baton Rouge fault (Site 1). There is a gradual decline in water levels with time for all main aquifers around Site 1. There is a gradual decline in water levels up to the 1940's/50's then a drastic decline up to 1960's/70's then again gradual up to the present time around Site 2. Both sites are affected by their proximity to the industrial area. Site 2, which is the closest, is drastically affected. Site 1, which is farther away, is less affected. Groundwater elevations north of the Scotlandville fault are higher than south of the fault, whereas water

elevations north of the Baton Rouge fault are lower than south of the fault due to heavy usage of groundwater in the industrial area which lies in between the two faults.

CHAPTER 1

INTRODUCTION

East Baton Rouge Parish, Louisiana, is situated on at least two fault zones, the Baton Rouge Fault and the Denham Springs-Scotlandville Fault (Scotlandville Fault). These faults were initially formed by passive margin rifting of Miocene age, but because of continuous sediment loading of Pleistocene up to and including Recent age, these faults have been reactivated, and are now termed growth faults. A growth fault is a fault that is or has been active during deposition of some of the stratigraphy it offsets, so much so that the thickness of the stratigraphy on the downthrown (southern block in the case of both faults) block increases in size drastically (McCulloh, 2001). Many studies have been done on these faults (eg. Cazes Master's Thesis, 2004; Kebede Master's Thesis, 2004; McCulloh, 2001; Sibley, 1972; Wintz et al., 1970; and Ocamb, 1961); however, very little has been done to image them in the subsurface or to trace actual ground surface structural damage into the subsurface. Historically most research has started by finding surface ground expressions, such as scarps or line scarps, of the faults and the research was therefore based on these escarpments (eg. Cazes Master's Thesis, 2004; and Sibley, 1972). Fault scarps are a result of the reactivation of the deeper older faults that, after a period of time has passed, the fault expression is observed at ground surface (McCulloh, 2001). Fault-line scarps are the same as fault scarps; however, they include erosion of the surface offset to make it less pronounced, this is what is the feature seen at one of the field study site locations (Glen Oaks High School). Several techniques were used to either gather field data or to research and compile previously acquired data in order to characterize the shallow subsurface character of the faults. These techniques include GPR, measuring displacement using a laser level, LIDAR, geodetic leveling, and hydrogeology.

GPR is a reflection geophysical surveying technique which uses radar waves to image the subsurface, and is similar to seismic reflection. However, it is used to image the subsurface at shallower depths. GPR has many applications in the engineering, geological and archaeological fields. The geological application covered in this study uses GPR for imaging the subsurface to determine if the effects of a fault observed at ground surface from structural damage to a building is present in the subsurface in the same location. GPR has been used to image shallow faults throughout the globe; such as normal faults in Spain and Italy (Reiss et al., 2003) and active faults in the Roer Graben in Belgium (Dermanent, et al., 2000). GPR and measuring with a laser level were used to acquire the field data, LIDAR, Geodetic Leveling and Hydrogeology were used to compile data for comparison purposes.

The compiling of LIDAR and Geodetic Leveling data was completed together because neither technique had sufficient data in the study areas. According to NASA's LIDAR tutorial (http://www.ghcc.msfc.nasa.gov/sparcle/sparcle_tutorial.html), LIDAR uses the same principle as RADAR. Of the three basic generic types of LIDAR available, range finder LIDARs are the simplest and are used to measure the distance from the transmitter to a solid or hard target. Range finder LIDARs are the type that has been consulted for this study because it can image elevation differences on the earth's surface. Of the three geodetic leveling techniques, I have chosen Differential Leveling, which is the most accurate of the vertical leveling techniques used presently (Burkard et al., 1983). Lastly, Hydrogeologic water level data was consulted to assist in determining whether fault movement such as subsidence is whole or partially due to ground water withdrawal, and to determine whether the faults act as non-permeable barriers to groundwater flow.

The aspect of hydrogeology that was researched for this study focused mainly on groundwater level elevations in the United States Geological Society (USGS) water wells, that were screened in main potable aquifers, and are located on either side of the faults studied. In particular, my focus was on the GPR field study areas which include the former Woodlawn High School and Glen Oaks High School. It is the purpose of this paper to test whether GPR is an effective tool in a geologic/hydrogeologic environment such as Louisiana, test whether it is possible to process GPR data without having to rely on seismic reflection processing technology, and to see if it is possible to compare LIDAR, Geodetic Leveling, and Hydrogeology data to one another in order to ascertain movement/subsidence along the faults and the fault's ability block fluid flow.

1.1 Study Area Geology

Sibley, et al. (1972) provides an extensive historical review, and John (2000) Baton Rouge Geologic Quadrangle provides an extensive recent view of Louisiana geology, which includes the types of soil lithologies, how they were deposited, and what structural influences have been exerted on these soil lithologies. For my study I have focused on the East Baton Rouge Parish area and surroundings. Lithologies of importance to this thesis range from the Miocene Epoch (11 to 25 Ma) to Recent (12,000 yrs ago to present). In my study areas the following formations are present from oldest to youngest: Hammond Alloformation (part of Prairie Alloformation, Early Sangamon, Prairie Terrace) which is Pleistocene in age, Natural levee and Crevasse complexes of the Mississippi River which are Holocene in age (part of Mississippi River Deposits), and Backswamp deposits which is also Holocene in age (John, 2000). The Hammond Alloformation is the lowest in elevation of the Prairie Terraces east of the Mississippi River, and is primarily composed of coastal plain deposits of late to middle

Pleistocene streams (John, 2000). The Prairie Terrace is exposed over most of East Baton Rouge Parish and is divided by both the Baton Rouge and Scotlandville faults (McCulloh, 2001). The natural levee and crevasse complexes are alluvium of the Mississippi River and are a combination of silty to sandy overbank deposits and crevasse splays, respectively. The most recent deposits in the area are the backswamp deposits of both the Mississippi and Atchafalaya rivers, comprised of fine-grained, clayey and organically rich sediments that underlie flood basins (John, 2000). These terraces/deposits combined make up the stratigraphic unit known as: Red River Alluvial deposits, Mississippi River Alluvial deposits, Northern Louisiana terrace deposits, and unnamed Pleistocene deposits (Stuart et al., 1994). Therefore, when coordinating potable groundwater drinking sources to these formations/stratigraphic units, they include the shallower aquifers (600-ft Sand and shallower). The most recent formation, River Deposits/Backswamp Deposits are characterized by floodplain and deltaic plain environments (Sibley, et al., 1972).

Cazes (2004) describe the evolution of the Gulf of Mexico (GOM) and the faults within this basin. Cazes provides a description of the faults themselves, and what forces affect the subsidence across the faults. I have briefly given a quick cursory look at the broader picture, and have summarized topics that directly relate to my thesis. Salvador (1991) provides an extensive description of the evolution of GOM basin where my study areas lie. The GOM basin was created as a result of Pangea experiencing a long rifting episode which lasted from the Late Triassic until Early-to-Middle Jurassic. Thick salt deposits of approximately Middle to Late Jurassic in age, recorded the first presence of seawater in the GOM basin. During the early Cretaceous period, with the subsidence of oceanic crust taking place in the basin, deformation of the Jurassic salt deposits and listric normal growth faulting began along the fringe of the GOM.

Cazes (2004), describes how the deforming salt base forms the basal décollement surface where the growth faults sole, including the Baton Rouge and Scotlandville faults which are the faults focused on in this study. However, the shallow depths at which these faults were studied for this thesis do not show any evidence of salts influence on the faults.

Ocamb (1961), defines growth faults as faults which have a “substantial increase in throw with depth and across which, from the upthrown to the downthrown block, there is a thickening of correlative section”. It has been suggested and generally accepted, that growth faults in the Baton Rouge area have developed contemporaneously with sedimentation. The normal growth faults in this area have been described as listric growth faults. Cazes (2004), describes how the depositional events into the GOM basin are characterized by an influx of land deposits from uplift and erosion in the northern section of the state. These Cenozoic deposits load the crust, which promotes subsidence to continue within the basin. Because of the shallow depths investigated for this study, it is difficult to determine if offsets or faults observed at such shallow depths are indeed growth faults; however, an assessment can still be made as to whether they are normal faults. Figure 1.1 shows a generic picture of a normal growth fault.

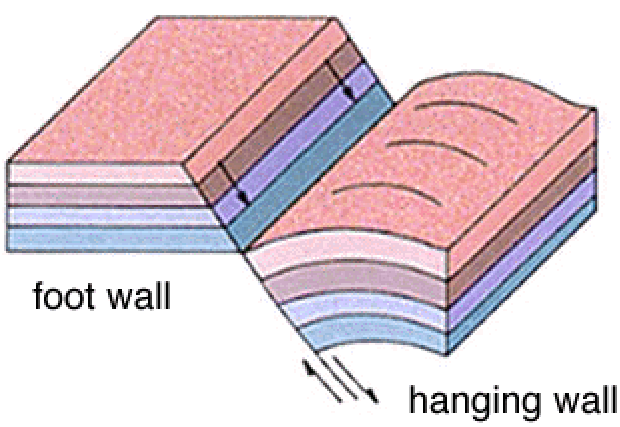


Figure 1.1 is a schematic drawing of a normal growth fault provided by Schlumberger. (http://www.glossary.oilfield.slb.com/DisplayImage.cfm?ID=105)

1.2 Study Area Hydrogeology

Tomaszewski, et al. (2002) summarized the Louisiana hydrogeology, and discussed in great detail the recent groundwater withdrawals and resulting elevation levels up to the year 2000. A synopsis of their work is provided herein to provide a framework of how the potable aquifers in the field study areas are situated. A figure included in the above referenced document, which was modified from Stuart et al. (1994), has been recreated and is included as Table 1.1 for this study and is a good summary of the hydrostratigraphy of aquifers in the state of Louisiana.

In Southeastern Louisiana the age of freshwater aquifers spans from Oligocene to Quaternary, and is known as the Southern Hills Regional Aquifer System. This system is comprised of 4 aquifer systems with several aquifers making up each system, and 6 interspersed confining or surficial confining units (Stuart, et al., 1994). The four aquifer systems in the Baton Rouge area are the Chicot Equivalent Aquifer System that is comprised of the Mississippi River Alluvial aquifer, Shallow Sand, 400-foot Sand and 600-foot Sand aquifers; the Evangeline Equivalent Aquifer System which is comprised of the 800-foot Sand, 1000-foot Sand, 1200-foot Sand, 1500-foot Sand and the 1700-foot Sand aquifers; the Jasper Equivalent Aquifer System which is comprised of the 2000-foot Sand, 2400-foot Sand and 2800-foot Sand aquifers, and the Catahoula Equivalent Aquifer System that does not have individual Sand aquifers. Of these aquifer systems, the only ones that pertain to my study are the Chicot Equivalent Aquifer System, the Evangeline Equivalent Aquifer System and the Jasper Equivalent Aquifer System (Sargent, 2000).

<table>
<tr><th colspan="8">Table 1.1
Hydrogeologic Column of Aquifers and Aquifer Systems in Louisiana (modified from Stuart and others, 1994)</th></tr>
<tr><th rowspan="4">System</th><th rowspan="4">Series</th><th colspan="2" rowspan="4">Stratigraphic Unit</th><th colspan="3">Hydrogeologic Unit</th></tr>
<tr><th colspan="3">Southeastern Louisiana</th></tr>
<tr><th colspan="2" rowspan="2">Aquifer System or Confining Unit</th><th>Aquifer[1] or confining unit</th></tr>
<tr><th>Baton Rouge Area</th></tr>
<tr><td>Quaternary</td><td>Pleistocene</td><td colspan="2">Red River alluvial deposits, Mississippi River alluvial deposits, Northern Louisiana terrace deposits, Unnamed Pleistocene deposits</td><td rowspan="8">Southern Hills Regional Aquifer System</td><td>Chicot Equivalent aquifer system or surficial confining unit</td><td>Mississippi River alluvial aquifer or surficial confining unit, Shallow Sand, "400-foot" Sand, "600-foot" Sand</td></tr>
<tr><td rowspan="7">Tertiary</td><td>Pliocene</td><td rowspan="5">Fleming Formation</td><td rowspan="2">Blounts Creek Member</td><td rowspan="2">Evangeline Equivalent aquifer system or surficial confining unit</td><td rowspan="2">"800-foot" Sand
"1000-foot" Sand
"1200-foot" Sand
"1500-foot" Sand
"1700-foot" Sand</td></tr>
<tr><td rowspan="5">Miocene</td></tr>
<tr><td>Castor Creek Member</td><td>Unnamed confining unit</td><td rowspan="3">"2000-foot" Sand
"2400-foot" Sand
"2800-foot" Sand</td></tr>
<tr><td>Williamson Creek Member, Dough Hills Member, Carnahan Bayou Member</td><td>Jasper Equivalent aquifer system or surficial confining unit</td></tr>
<tr><td>Lena Member</td><td>Unnamed Confining Unit</td></tr>
<tr><td colspan="2" rowspan="2">Catahoula Formation</td><td rowspan="2">Catahoula Equivalent aquifer system or surficial confining unit</td><td rowspan="2"></td></tr>
<tr><td>Oligocene</td></tr>
</table>

In general the hydrogeologic setting for the Southern Hills Regional Aquifer System in East Baton Rouge Parish is a sequence of complex interbedded, interconnected, lenticular, freshwater bearing, sandy/gravely strata of fluvial origin that form a wedge of sediment that dips and thickens to the south (Griffith and Lovelace, 2003). There are a total of 12 freshwater aquifers which are composed of very fine to coarse sands and pea to cobble size gravels (Meyer and Turcan, 1955). These aquifers are separated by confining units composed of clays and/or silts of varying thicknesses that range from 30m to more than 100m. As in the case of the confining units, the aquifers vary in thicknesses throughout East Baton Rouge Parish. The major aquifers have been known to vary in thicknesses from 20m to 100m (Nunn, 2003). In most cases the main form of recharge for these aquifers is a combination of precipitation and some infiltration of surface water that has percolated down into the deeper aquifers from the outcropped area that extends north into Mississippi (Griffith and Lovelace, 2003). From where the aquifers recharge, water moves downward and southward, driven by topographic gradient (Nunn, 2003). A prominent hydrologic boundary feature to the south for all of these aquifers is the Baton Rouge Fault, which runs east to west across the city. Also, historically groundwater elevations in the deeper aquifers in the Baton Rouge area were above ground surface and in some cases artesian (Nunn, 2003). In the literature reviewed there is no direct mention of the Scotlandville fault working as a hydrologic boundary feature. However, upon review of cross-sections (such as Figure 1.2) that cross over both faults, the Scotlandville fault appears to have subsided similarly to the Baton Rouge fault which would suggest a similar hydrologic response.

Historically there have been many studies on the aquifers in the Baton Rouge Area, their connectivity across the faults, the influence of their use on subsidence across the faults. Kazmann (1970) constructed a cross section just east of the Mississippi River using USGS wells from either side of both the Scotlandville and Baton Rouge faults. Through reviewing this cross-section, it must be noted that he included one additional shallow sand aquifer labeled as the University Sand which is between the river alluvium aquifer and the 400-ft Sand, and he has not distinctly labeled the 1000-ft or 1700-ft Sands. However, there are sands that have been included in the Kazmann (1970) cross-section that are not labeled and are in the depth range of both the 1000-ft and 1700-ft Sands. Starting on the north side working southward, from deep to shallow aquifers:

- The 2800-ft Sand is shifted downward by the Scotlandville fault, and then pinches out before coming into contact with the Baton Rouge fault;
- The 2400-ft Sand if observed north of the Scotlandville fault is discontinuous and not very thick; however, moving southward towards the Baton Rouge Fault it increases in thickness, is shifted downward south of the fault and it's thickness decreases;
- The 2000-ft Sand is shifted downward by the Scotlandville fault and further downward by the Baton Rouge fault;
- The unlabeled 1700-ft Sand is discontinuous north of the Scotlandville fault, shifted downward on the southern side of the fault, and appears to be discontinuous and possibly does not exist or maybe connected with the 1500-ft Sand approaching the Baton Rouge fault;
- The 1500-ft Sand if observed north of the Scotlandville fault is discontinuous and not very thick, it tends to pick up south of the fault and is interbedded with silts/clays up to the Baton Rouge Fault where it is shifted downward;
- The 1200-ft Sand is shifted downward by the Scotlandville fault, thins out approaching the Baton Rouge fault, and is shifted further downward south of the Baton Rouge fault;
- The unlabeled 1000-ft Sand is discontinuous throughout the cross-section and does not seem to be directly cut by either faults;

- The 800-ft, 600-ft and 400-ft Sands are all shifted downward by the Scotlandville fault and further downward by the Baton Rouge fault.

Figure 1.2 is a recreation of Kazmann's Figure 4 which shows visually the divisions of these aquifers and how they are shifted along the faults. Prior to extensive use of some of these deeper aquifers, such as the 1500 ft and 2000 ft Sand aquifers, as a potable water source, water levels in Baton Rouge were above land surface, i.e. artesian aquifers (Nunn, 2003).

Kazmann (1970) summarized the geologic/hydrogeologic processes that have taken place in the past and continue to affect land subsidence along the faults including the areas around both the former Woodlawn High School and Glen Oaks High School. Because most of the aquifers in the Baton Rouge area are artesian, it can be assumed that they are bounded both on top and bottom by aquiclude clay/silt layers. These aquicludes, though impermeable, are still saturated with groundwater. Prior to any human impact on these groundwater aquifers, both the artesian aquifer and aquiclude are in complete hydrostatic equilibrium with one another, and no flow between them (Nunn, 2003). Once human activities began to drain the aquifers, the water pressure in the sands dropped off and leakage from the confining layers began. Because the water in the clay confining layer helped to support the overhead load, the clays compacted/consolidated due to an increase in effective stress. It must also be noted that compaction/consolidation can only function as fast as pore fluid can escape (be pumped by wells) from the rock/soils (Nunn, 2003). Therefore, the initial thickness of the clay layers is reduced, and the overlying sediments move or subside. The time it takes for this process to complete depends on several factors; such as, the rate and magnitude of pressure drop in the aquifer and types of clays separating the aquifers.

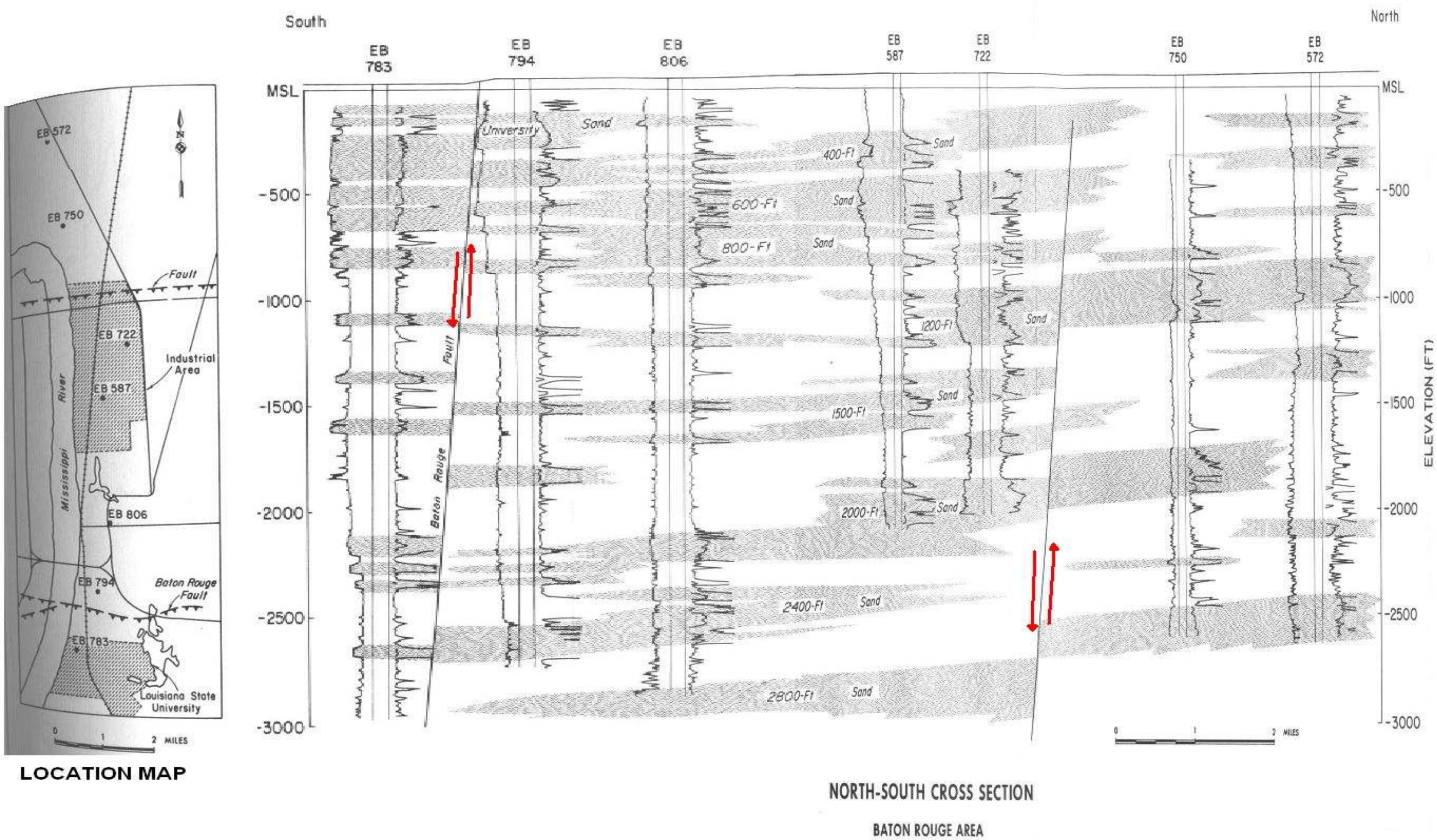


Figure 1.2, North to South Cross Section, from Kazmann 1970 that borders the Mississippi River to the east and runs across both the Baton Rouge and Scotlandville faults.

Through Kazmann's work (1970), he determined that a good rule of thumb for rate relations of subsidence vs. groundwater level drop was for every 100 foot drop in groundwater level there would be a resultant subsidence of 0.5 to 1.5 feet. Also, according to his study Kazmann attributes the main offtake (potable) aquifers, those deeper then the 800-ft Sand, as being the cause for most of the subsidence. From 1938 to 1964 he measured a subsidence of 0.6 to 0.7 ft; however, he theorized that this would both continue and get worse in the future unless things changed.

In the more recent study, by Nunn (2003), working with current values of subsidence as well as, projected values for the future. Nunn (2003) projected total subsidence of 0.669 m to 0.765 m by 2010 depending on whether water levels remain constant or continue to decline. According to his study, land surface subsidence continues long after groundwater levels in aquifers have lowered enough to activate drainage from the overhead clay confining unit. The length of time it takes for the clay confining unit to regain equilibrium with declining groundwater levels in the adjacent aquifer depends on the clay layer thickness (Nunn, 2003).

1.3 Study Objectives

The purpose of this thesis was to study both the Baton Rouge and Scotlandville faults at shallow depths, determine the relative amount of subsidence along each fault, and determine whether these faults are barriers to fluid flow and to whether the increase in groundwater withdrawal impacts the amount of subsidence. The main objective for this thesis was to test Ground Penetrating Radar (GPR) equipment, to see if the equipment can trace surface expressions of faults into the subsurface, and its resolution and depth of penetration in studying shallow faults in climate and soils found in Louisiana. A secondary objective to the previous is to measure the amount of subsidence observed along man-made structures in order to evaluate the amount of relief observed across the faults and to determine whether they are currently active. Another secondary objective was to use the Sensors & Software Reiss et al. (2003), discussed that if field data acquisition and settings/techniques are good during field work then the GPR data will require little to no reprocessing. Their study area however, was in clean sand with little to no clays. Reiss et al. also mentions that one of the main reasons for a lot of reprocessing, besides possible errors in data acquisition, is due to soils similar to what I have encountered during this thesis, such as silts/clays and particularly moist to wet silts/clays. A secondary objective that is linked to the above is to use the Sensors & Software GPR computer programs, WinEkko, Ekko_View Enhanced, and Ekko_View Deluxe to analyze the field data, instead of seismic processing programs.

The second main objective is multifaceted and includes looking at LIDAR and its corresponding elevation contours, geodetic leveling data, and hydrogeology data (levels from USGS groundwater wells) both adjacent to and in the vicinity of the field study areas. I was trying to determine if evidence of fault activity is shown by LIDAR and or geodetic leveling data. I also used a combination of LIDAR, historical and recent geodetic data and hydrogeology records, for the field study areas investigated, to determine whether the growth faults form non-permeable barriers to groundwater flow. In addition, a study was conducted to evaluate the role of groundwater withdrawal on subsidence along both the Baton Rouge and Scotlandville faults.

CHAPTER 2

FIELD METHODOLOGIES – GPR

Ground Penetrating Radar (GPR) is a reflection geophysical technique for high resolution imaging of the shallow subsurface. GPR was chosen for this study because of its ability to collect subsurface reflection data from shallow depths. At each of the field study areas, displacement was observed at the earth's surface due to recent (<40 years) movement on the faults. GPR provided the ability to image the faults observed at the surface into the shallow subsurface. Because the field equipment capabilities had not been completely tested and/or proven, I also conducted experiments initially at several test site areas.

The field equipment set up is a Sensors & Software PulseEKKO 100 bi-static operation system, with digital timing control, digital data acquisition and fibre optic cabling throughout. In general the set-up includes the following basic equipment: transmitter, receiver, power source, fibre optic cabling, 100MHz and 200MHz antennas, adjustable antenna holders and cart to hold the antennas, odometer, junction box with fast port, and a portable laptop to run the computer data acquisition program. At both test sites and field study areas, the following procedures were followed:

- First a choice was made as to what was more important to image in the subsurface at a given location, resolution or depth, and then the appropriate antenna was used. The 100MHz antenna has greater depth penetration; the 200MHz antenna has greater resolution. One antenna was attached to the transmitter and one to the receiver. Both the 100 and 200 MHz antenna were used for this study.
- The transmitter sends out the signal using a 400V power source.

- The receiver records the amplitude and arrival time of energy reflected from the subsurface as well as the air wave which is transmitted directly from transmitter to receiver.
- Both the transmitter and receiver, and their corresponding antennae, are attached to either the adjustable antenna holders or the antenna cart with odometer, and are separated by a constant minimum distance of 1.0m or 0.5m, when using the 100MHz and 200MHz antenna respectively. This minimum distance is required to avoid data aliasing. Sheriff (2002) describes aliasing as "Ambiguity resulting from the sampling process. … an input signal at one frequency yields the same sample values as (and appears to be) another frequency."
- Whether the antennae are attached to the cart/odometer or to the adjustable holders, the data is still collected based on a metric step size. For the cart/odometer collection method, once the odometer has measured out the step size that has been entered into the data acquisition program, the power source emits a pulse into the ground. For the adjustable holders collection method, a step size is still entered into the data acquisition program; however, the pulse is not triggered until the time delay period has ended. The time delay allows for the antennas to be picked up and moved by hand to the next distance interval.
- The transmitter, receiver, and odometer are attached to a junction box by fiber optic cables.
- The junction box is attached to a laptop computer that runs the data acquisition program PulseEKKO 100.

- The PulseEKKO 100 program parameter set up varied from location to location as detailed below.

Figure 2.1 is a picture of the GPR adjustable holders which were used inside the buildings at the former Woodlawn High School and for all data acquisition at the Glen Oaks High School. Figure 2.2 is a picture of the GPR cart set up which was used for all of the transects outside the former Woodlawn High School Band Room/Auditorium complex.

Figure 2.1. GPR adjustable holders, 100 MHz antennas, transmitter and receiver, fiber optic cables would be connected to both transmitter and receiver and connect back to the junction box. Recreated from Sensors & Software website, http://www.sensoft.ca.

Figure 2.2. GPR cart, 100 MHz antennas, odometer, transmitter and receiver, and fiber optic cable running back to hook into the junction box.

Table 2.1 shows each of the computer data acquisition submenus available through using the PulseEKKO 100 software. The main menus within the software include the Layout, Options, System, Field Line, Gains and Job. The submenus that vary from site to site are Start Position, Operation Mode, Start Delay, Step Size which is only different for the LSU Parade Grounds site, Move Delay (all within the Field Line main menu), Frequency which is only

TABLE 2.1
DATA ACQUISITION PROGRAM SET UP

PROJECT	Start Position (m)	Operating Mode	Survey Type	Starting Delay (s)	Step Size (m)	Antenna Separation (m)	Pause Trace
Test Site 1	1.00	Step	Reflection	0.00	0.30	1.00	0.00
Test Site 2	0.00	Continuous	Reflection	10.00	0.10	0.50	0.00
	1.00	Continuous	Reflection	10.00	0.10	1.00	0.00
Former Woodlawn High School	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00
	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00
	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00
	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00
	1.70	Step	Reflection	0.00	0.10	1.00	0.00
	1.70	Step	Reflection	0.00	0.10	1.00	0.00
	1.70	Step	Reflection	0.00	0.10	1.00	0.00
	1.70	Step	Reflection	0.00	0.10	1.00	0.00
	1.70	Step	Reflection	0.00	0.10	1.00	0.00
	1.70	Step	Reflection	0.00	0.10	1.00	0.00
	0.00	Step	Reflection	0.00	0.10	1.00	0.00
	0.00	Step	Reflection	0.00	0.10	1.00	0.00
	0.00	Step	Reflection	0.00	0.10	1.00	0.00
	1.70	Step	Reflection	0.00	0.10	1.00	0.00
	1.70	Step	Reflection	0.00	0.10	1.00	0.00
	0.00	Step	Reflection	0.00	0.10	1.00	0.00
	0.00	Step	Reflection	0.00	0.10	1.00	0.00
	0.00	Step	Reflection	0.00	0.10	1.00	0.00
Glen Oaks High School	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00
	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00
	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00
	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00
	0.00	Continuous	Reflection	10.00	0.10	1.00	0.00

Notes: D-Default Setting is this

TABLE 2.1 (Cont.)							
	FIELD LINE	GAINS	JOB		LAYOUT	OPTIONS	
PROJECT	Move Delay (s)	Type-Amount	AutoName	Pulsar Voltage (V)	Trace	Correction	Velocity (m/ns)
Test Site 1	0	Const. 50	PARADE	400.00	Wiggle	DEWOW	0.1
Test Site 2	5-7	Const. 50	LEE	400.00	Wiggle	DEWOW	0.1
	5-7	Const. 50	LEE	400.00	Wiggle	DEWOW	0.1
Former Woodlawn High School	5-7	Const. 50	BAND1	400.00	Wiggle	DEWOW	0.1
	5-7	Const. 50	BAND2	400.00	Wiggle	DEWOW	0.1
	5-7	Const. 50	WAYWALK1	400.00	Wiggle	DEWOW	0.1
	5-7	Const. 50	WAYWALK2	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WD2_L2F	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WD2_L3F	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WD2_T13F	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WD2_T13R	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WD2_T6F	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WD_T23R	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WOOD1_4	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WOOD1_8	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WOOD2_8	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WOOD2_L1	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WOOD2_T3	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WOOD3_8	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WOODNEW	400.00	Wiggle	DEWOW	0.1
	0	Const. 50	WOODNEW2	400.00	Wiggle	DEWOW	0.1
Glen Oaks High School	5-7	Const. 50	DVWY1	400.00	Wiggle	DEWOW	0.1
	5-7	Const. 50	OSWLKWY1	400.00	Wiggle	DEWOW	0.1
	5-7	Const. 50	WLKWY1	400.00	Wiggle	DEWOW	0.1
	5-7	Const. 50	WLKWY2	400.00	Wiggle	DEWOW	0.1
	5-7	Const. 50	WLKWY3	400.00	Wiggle	DEWOW	0.1

Notes: D-Default Setting is this

TABLE 2.1 (Cont.)					
PROJECT	SYSTEM				
	Time Window (ns)	Frequency (MHz)	Sampling Interval (ps)	Number of Stacks	Points (per trace)
Test Site 1	512	100	800	32	640
Test Site 2	512	200	800	16	640
	512	100	800	4 or 32	640
Former Woodlawn High School	512	100	800	4	640
	512	100	800	4	640
	512	100	800	4	640
	512	100	800	4	640
	512	100	800	4	640
	512	100	800	4	640
	512	100	800	4	640
	512	100	800	8	640
	512	100	800	4	640
	512	100	800	8	640
	512	100	800	4	640
	512	100	800	8	640
	512	100	800	8	640
	512	100	800	4	640
	512	100	800	4	640
	512	100	800	8	640
	512	100	800	8	640
	512	100	800	8	640
Glen Oaks High School	512	100	800	16	640
	512	100	800	16	640
	512	100	800	8	640
	512	100	800	8	640
	512	100	800	8	640

Notes: D-Default Setting is this

different for the St. Francisville site, and the number of stacks chosen (both within the System main menu). The following subsections review the specific details of the computer data acquisition software for each site location and the field acquisitions at each test site location:

2.1 TEST Site 1, Louisiana State University (LSU) Parade Grounds

The LSU Parade Grounds (Figure 2.3) were used as a testing ground for the overall GPR field equipment apparatus in general, plus the antenna cart and odometer in particular. The 100 MHz antennae were attached to the cart at a constant distance of 1m. The survey was set up to record based on distance covered, which was measured by the odometer. The distance between each shot (power source 400v pulse of energy emitted from the transmitter into the air and ground beneath) was 0.3 meters. Two transects were surveyed at the Parade Grounds with the set up for the Pulse Ekko100 computer data acquisition software shown in Table 2.1. The only columns (main menu and corresponding submenus) in Table 2.1 within the data acquisition software that are unique to this test site survey are the following:

- Field Line – step size of 0.3m, and
- System- the number of stacks was set up for 32.

The phrase 'stacking of data' refers to the amount of traces received at one point that are added together to create one composite average trace for that horizontal distance location. Stacking of trace data like this helps to improve the signal to noise ratio. All the remaining data acquisition submenus are similar in nature to those of the other test site and field sites. Both transects were recorded on the west side of Highland Road, and both north and south of the sidewalk transects led from the War Memorial on the LSU Parade Grounds. Errors were found when reviewing the data in the field. Traces were missed, skipped or not recorded by the GPR equipment while using the antenna cart and odometer equipment. According to personal communication with Greg Johnston (2005) Sensors and Software technician, traces are skipped when the cart is being pushed/pulled too fast for the odometer to finish collecting one trace before the next one is triggered to be collected. Mr. Johnston confirmed what I determined in the field, that by reducing speed and number of stacks, the number of skipped traces can be reduced.

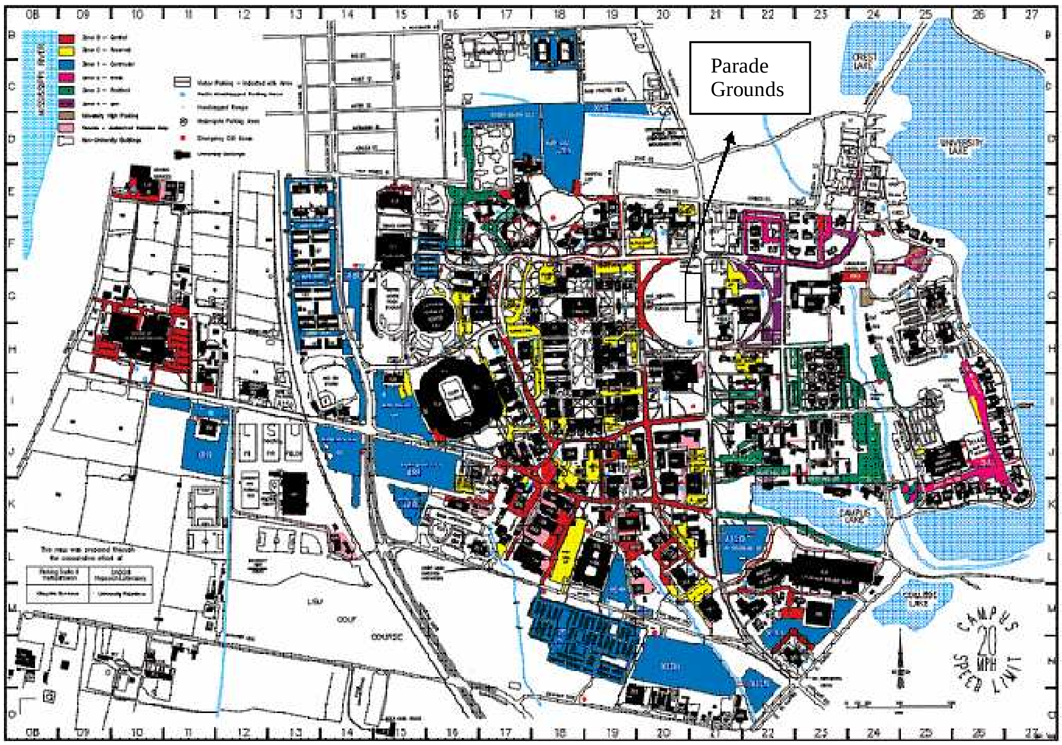


Figure 2.3. Test Site 1, LSU Parade Grounds.

2.2 TEST Site 2, St. Francisville

The St. Francisville sites (Figure 2.4) were used as a testing area for the overall GPR field equipment apparatus in general, testing the equipment's ability to locate shallow graves because the local sheriff's office were looking for human remains, plus using the adjustable antenna holders instead of the cart and odometer. The 100 MHz and 200 MHz antennae were used at these sites and were separated by the appropriate measured lengths of rope, 1.0 m and 0.5 m respectively. The survey was set up to record based on a time delay with an initial start delay of approximately 10 s and a move delay (delay between each shot location) of 5-7 s. The distance between shots was 0.10 meters as measured on a metric measuring tape placed along the survey line. Twelve transects were surveyed at the St. Francisville sites with an identical data acquisition software set up to the LSU Parade Grounds except for the following columns (main menu and corresponding submenus) in Table 2.1 within the data acquisition software that are unique to this test site survey:

- <u>Field Line</u> – start delay of 10s, and a move delay of between 5 and 7 s, and for
- <u>System</u>- the number of stacks was set up to be 16 for the 200 MHz antennae and either 4 or 32 for the 100 MHz antennae.

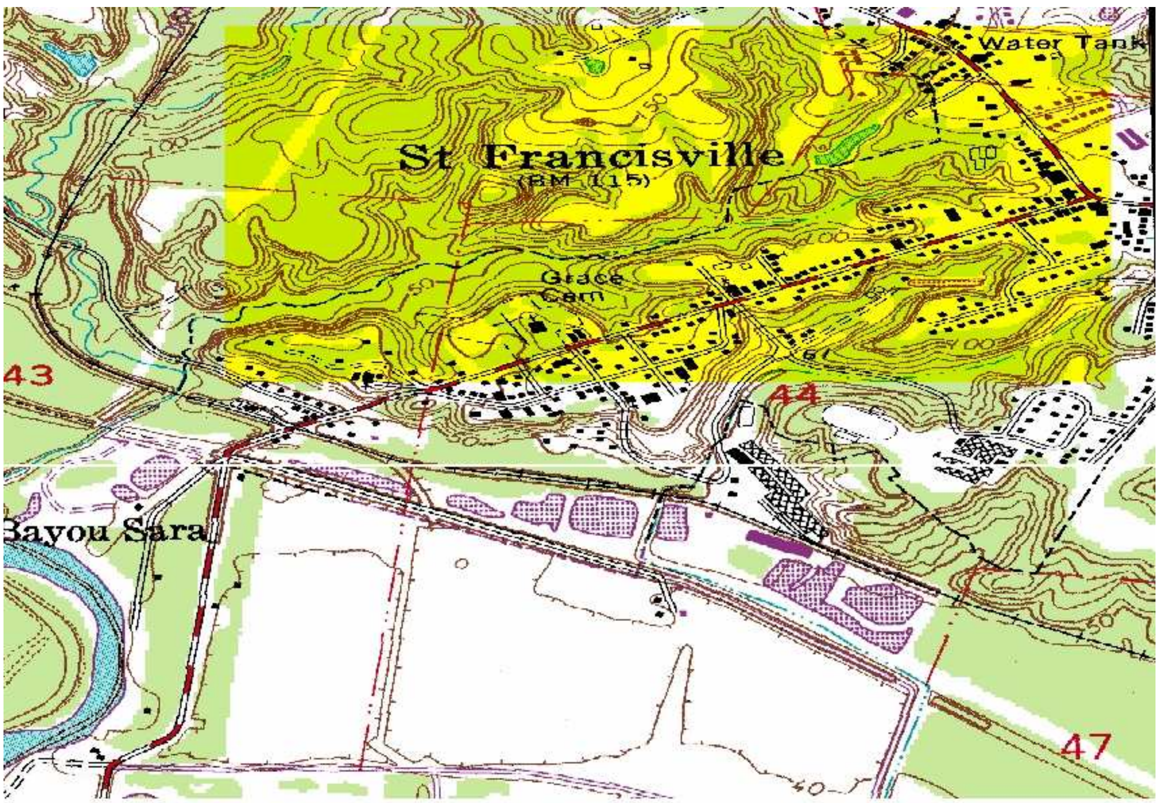


Figure 2.4. Test Site 2, St. Francisville.

The following subsections review the details of the field study area GPR data acquisitions which includes the former Woodlawn High School and Glen Oaks High School. Prior to acquisitions of GPR data, a review and retrieval of structural blue prints for each of the high schools was performed. The review was performed to locate subsurface man-made features such as pipes, culverts, thicknesses of foundations and or retaining walls for use during both field activities and data interpretation. During the background check on the former Woodlawn High School a 1.5-inch gas pipe line was observed on the construction blue prints parallel and adjacent to the west side of the band room and several feet away from the band room on the south side. During the background check on the Glen Oaks High School, several utility lines were located in the areas of data acquisition. In the case of the covered walkway, a 3-inch gas pipeline and a 6-inch water pipeline were observed running underneath the concrete on the blueprints for the school. In the case of former Building H that was demolished because fault activity had destroyed the structural integrity of this building, there were several utility pipes that used to run into the building. These pipes have been blinded near the edge of the covered walkway. The plans did not show buried utilities underneath the asphalted parking lot on the western side of the Glen Oaks High School. Copies of these blue prints are included as Appendix A.

2.3 Field Study 1, Former Woodlawn High School

Woodlawn High School was built in the late 1950's and was demolished in 2004, in part due to the structural damage the Baton Rouge fault caused to the onsite buildings (Band Room/Auditorium complex) during this time frame. East Baton Rouge Parish school district is still using the former Woodlawn High School property to reconstruct a new middle school in the area of the old practice fields, with the assumption that this will be far enough away from the influence of the fault. The Woodlawn High School (Figure 2.5) field study was conducted in a similar manner to the LSU Parade Grounds study. However, the odometer was tested more completely during this field study, which included adjusting the numbers of stacks to be recorded along each transect. The number of stacks needed to be adjusted because even though the survey was set up to take a reading every 0.1m, if the cart was moved too fast some traces were missed in the survey data. I confirmed with Sensors and Software that if the odometer triggers for a new shot point before the previous trace is completed then the software just skips that shot, as a result the stacking during data acquisition was limited to either 4 or 8 stacks. (Greg Johnston, personal communication 2005) A total of 14 transects were surveyed near the condemned buildings on the western side of former Woodlawn High School, the former band room and auditorium, in the area where the effects of the Baton Rouge Fault were observed at ground surface. In addition to the previous, a total of 2 transects were surveyed within the band room, and 2 transects were surveyed along walkways that surround the band room/auditorium complex, again in the areas where the effects of the Baton Rouge Fault were observed. The 100 MHz antennae were used both with the cart and the adjustable antenna holders at a constant distance of 1 m. A total of eighteen transects were surveyed at the former Woodlawn High School site (Figure 2.6). Software acquisition parameters are the same as the LSU Parade Grounds survey, except for the following columns (main menu and corresponding submenus) in Table 2.1 within the data acquisition software that are unique to this survey:

- Field Line – start delay of 10s, and a move delay of between 5 and 7 s four transects surveyed inside the buildings, and for
- System- the number of stacks was set up to be between 4 and 8.

In addition, a laser level was used to measure the fault offset along the onsite structures. In particular, the band room was measured along the interior west wall at varying locations where the structural damage was observed to be the worst.

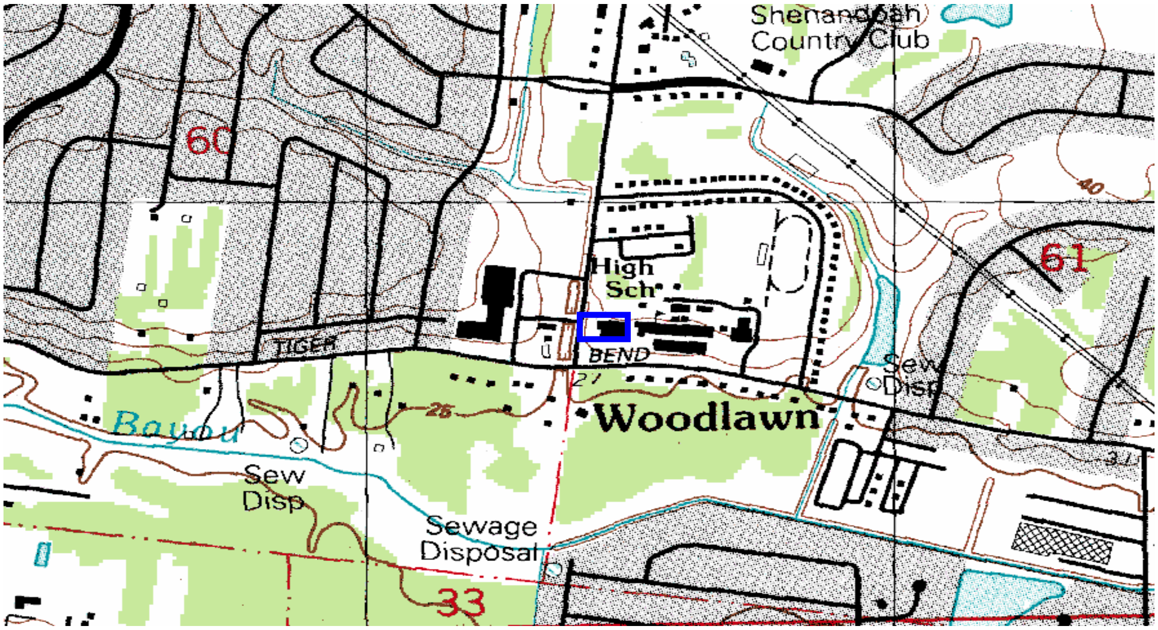


Figure 2.5 Topographic map of the former Woodlawn High School property, the area in blue is the Band Room/Auditorium complex. North is to the top of the page.

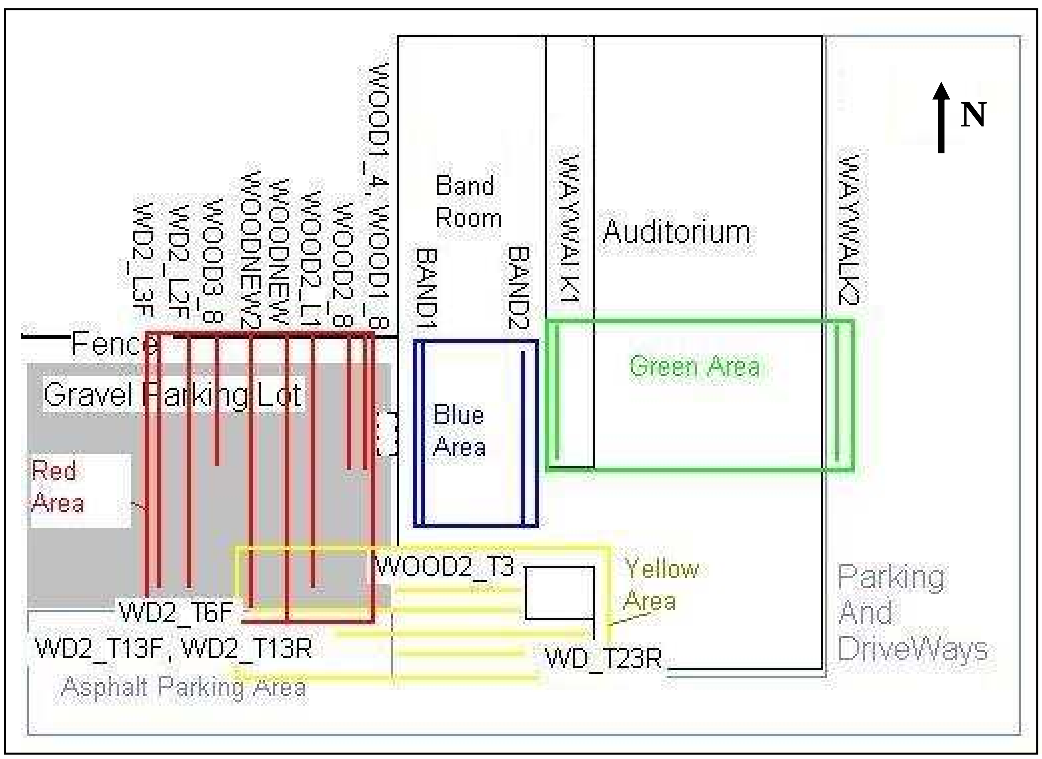


Figure 2.6. Site Map of GPR transects at Former Woodlawn High School Field Study Area. North is to the top of the page. The WOOD1_4/WOOD1_8 through WD2_L3F are the names of the transects in the red area, the BAND1 and 2 are the transects in the blue area, WAYWALK1 and 2 are the transects in the green area, and WOOD2_T3 through WD_T23R are the transects in the yellow area.

2.4 Field Study 2, Glen Oaks High School

The Glen Oaks High School (Figure 2.7) field study was conducted similar to the St. Francisville sites by using the adjustable antenna holders for the antennae. The 100MHz antennae were used for this field study and were separated by a 1m length of rope. The survey was set up to record based on a time delay with an initial start delay of approximately 10s and a move delay of 5-7s. The distance between shots was 0.10m. Six transects were surveyed at the Glen Oaks High School facility (Figure 2.8) with data acquisition parameters identical to the St. Francisville site except for the System column in Table 2.1, where the number of stacks was set up to range from 4 to 8 to 16.

In addition, a laser level was used to measure the fault offset along the concrete and asphalted areas onsite. In particular, the curbs that outline the front parking area for the school were measured where the structural damage was observed to be the worst.

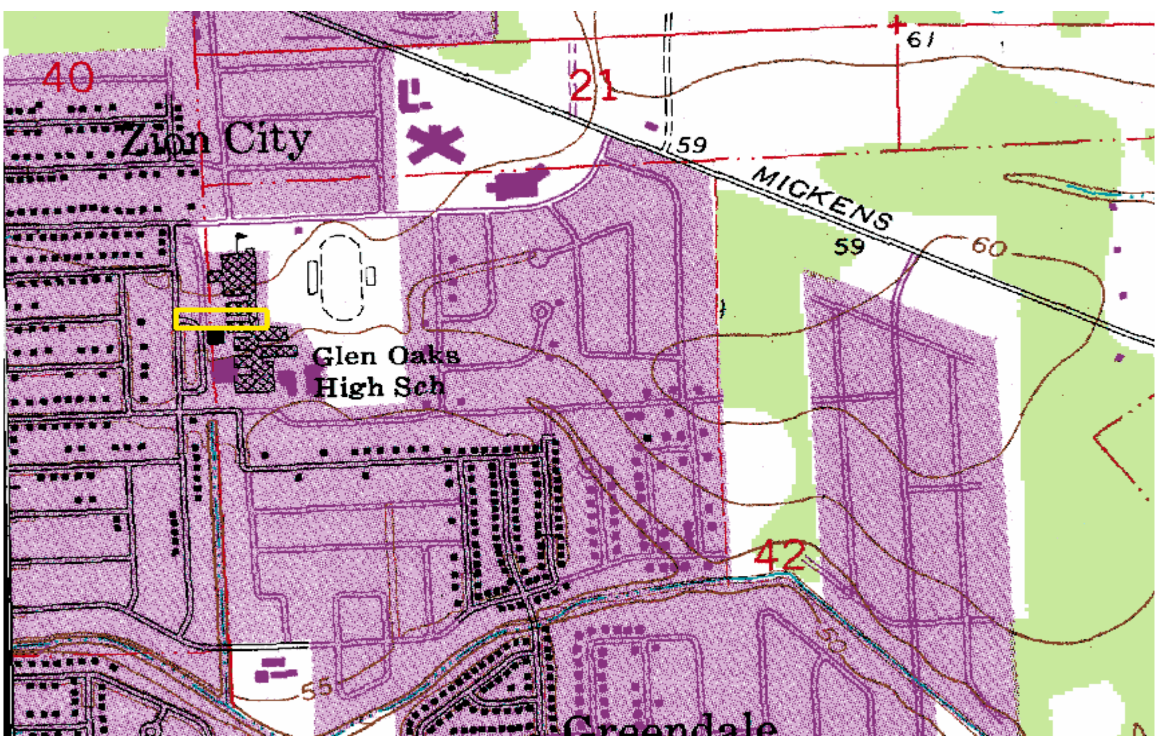


Figure 2.7, Topographic map of the Glen Oaks High School Property, the area in yellow is the historic Building H.

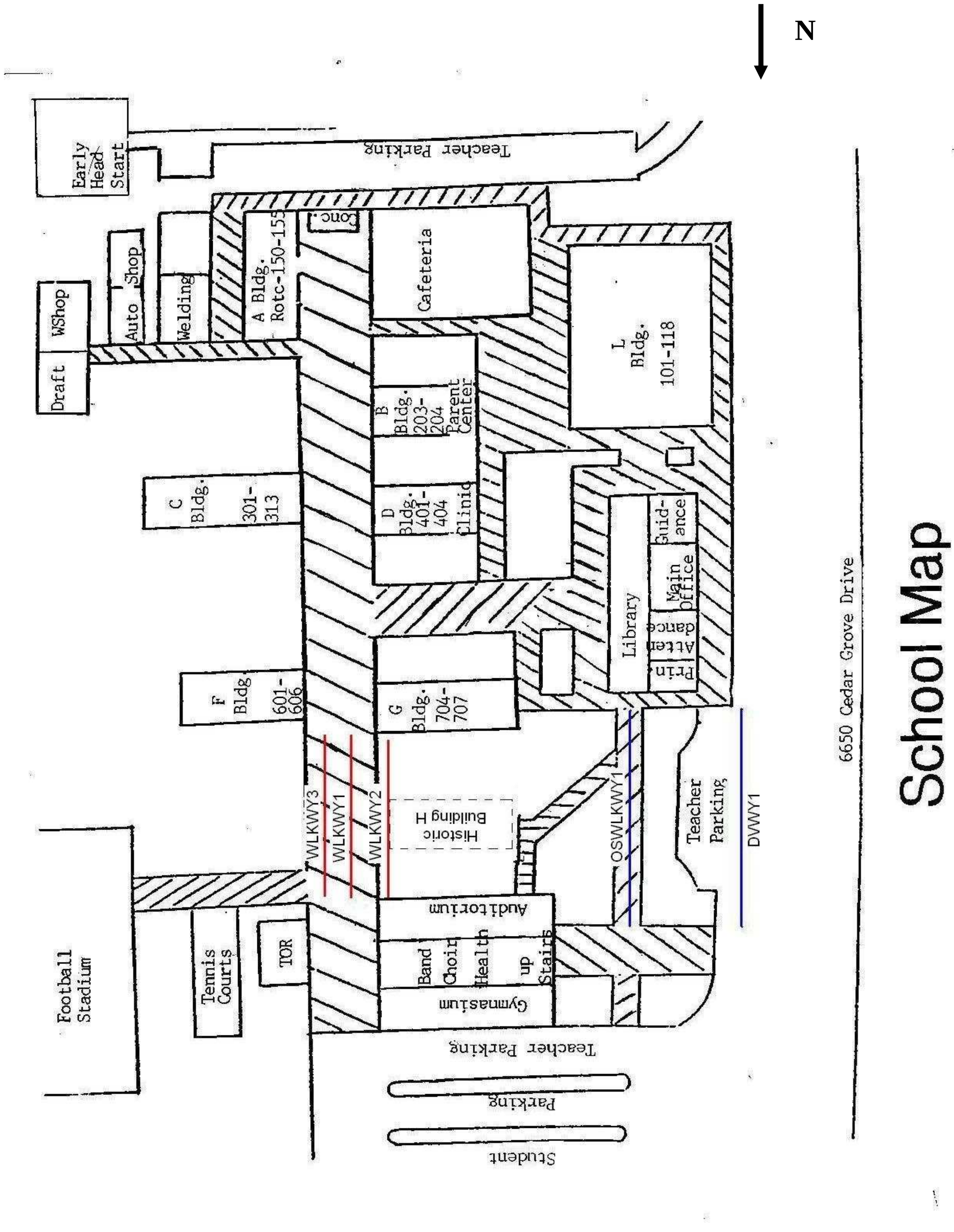


Figure 2.8. Site Map of GPR transects at Glen Oaks High School Field Study Area.

CHAPTER 3

DATA PROCESSING METHODOLOGIES

A secondary objective that is linked to the testing of the GPR field equipment was to use the Sensors & Software (Sensoft) GPR computer programs, WinEkko in conjunction with Transform 2D, and Ekko_View Enhanced in conjunction with Ekko_View Deluxe to analyze the field data, instead of using seismic processing software. Each of the GPR transects have been processed using the Sensoft programs that are formatted specifically for GPR data. Both Excel and AVGREMOVE.F/ar6 programs were also tested to see their effectiveness at removing the air wave and to compare with the Sensoft air wave removal algorithm, Background Subtraction.

3.1. Historical Processing

All raw data was uploaded into the Win_Ekko/Transform 2D Programs in order to view the data in the field. The two LSU Parade Ground transects, the initial 12 former Woodlawn High School transects, and 12 St. Francisville transects were cropped and viewed for initial geologic interpretation and quality control. An attempt was made to do a SEGY data dump of the GPR data in order to upload into Landmark Graphic Software. However, the conversion program contains an error. Sensoft was notified.

Dr. George A. McMechan and Xiaoxian Zeng, with the Center for Lithospheric Studies at the University of Texas at Dallas, provided an air wave filtering program for GPR data. Mr. Zeng provided two FORTRAN programs to be used on a SUN workstation, one that would perform a time zero alignment and one that would remove the air wave. After some calibrations of the test site transects from the LSU Parade Grounds, the program was run on transect Parade 1 to evaluate the software.

The time zero filtering programs, tzs, shifted the time zero from 90 nanoseconds for the original data to 20 nanoseconds after using the filtering program. This adjustment was to reset the time zero value to the arrival of the air wave. Secondly the air wave filtering program, AVGREMOVE.F or ar6, was used and according to the text message within the program, the average removal was performed.

While loading the filtered Parade Grounds project file with the processed transect Parade 1, several error messages were posted that stated there was no data in those particular trace files and therefore were skipped when the project was uploaded to the Win_Ekko program. Essentially the main issue with this process was that there were problems with the software because data was missing with the original raw transect data. Also, when viewing the Transform 2D images of the transect Parade 1, both after the tzs and ar6 filtering programs, data are missing with this transect due to problems with the software.

Data interpretation was performed comparing the traces and the Transform 2D images of the filtered transect Parade 1 data. The traces appeared very similar when comparing the raw data to the time shift data to the averaged data, except that the time zero data had shifted. Because data is lost during the use of these software programs, they were not used for the overall processing of the data.

3.2. Recent Processing

As this project progressed, we were able to obtain the upgraded Sensoft computer data processing packages, Ekko_View Enhanced, Ekko_View Deluxe, and Ekko_View. All raw and processed transects are included in Appendix B. As a result, a topographic correction process was available; however, due to the traces covering such short distances and the surficial slope changing minimal, this process was not used during data manipulation. Also, a new version of the AVGREMOVE.F or ar6 program was obtained from Mr. Zeng to again try and remove the airwave.

The raw data is again uploaded into the Sensoft data processing programs. As noted in Chapter 2 Field Methods, as all of the data is collected a DEWOW filter was applied to remove the low frequency ‘WOW’ signal that is superimposed on higher frequency reflectors. The next step in processing was to remove the airwave from the raw data. The airwave removal process entailed a comparison between the Sensoft Background Subtraction spatial filter to the Excel Spreadsheet averaging filter, to the AVGREMOVE.F filter, to determine which was the most effective and user friendly to continue with data processing.

In removing the airwave the assumption is made that the distance between source and receiver is the same for all traces. Thus, the airwave should arrive at the same time for each trace. In all airwave filtering programs used herein, the airwave is removed from each trace by removing an averaged trace. The averaged trace value is calculated by averaging the traces on either side. This process continues throughout the transect from the first trace to the last trace.

A detailed description and comparison of each of the air wave removal processes is included in Appendix C. The Sensoft Background Subtraction spatial filter, using an average across 41 traces allowed for the removal of the airwave without removing or averaging out the deeper reflectors observed in the raw data. Since the difference between AVGREMOVE.F vs. Background Subtraction Programs becomes smaller with an increase in the number of traces averaged, I continued to use the Sensoft Background Subtraction Program, as long as the number of traces chosen to be averaged over is not such a small number that certain deeper geologic features observed in the Raw Data are removed. When reviewing the Wiggle trace to compare the Raw Data (Figure 3.1a) versus the Background Subtraction air wave removal program (Figure 3.1b) using an average of 41 traces, the air wave was removed successfully removed.

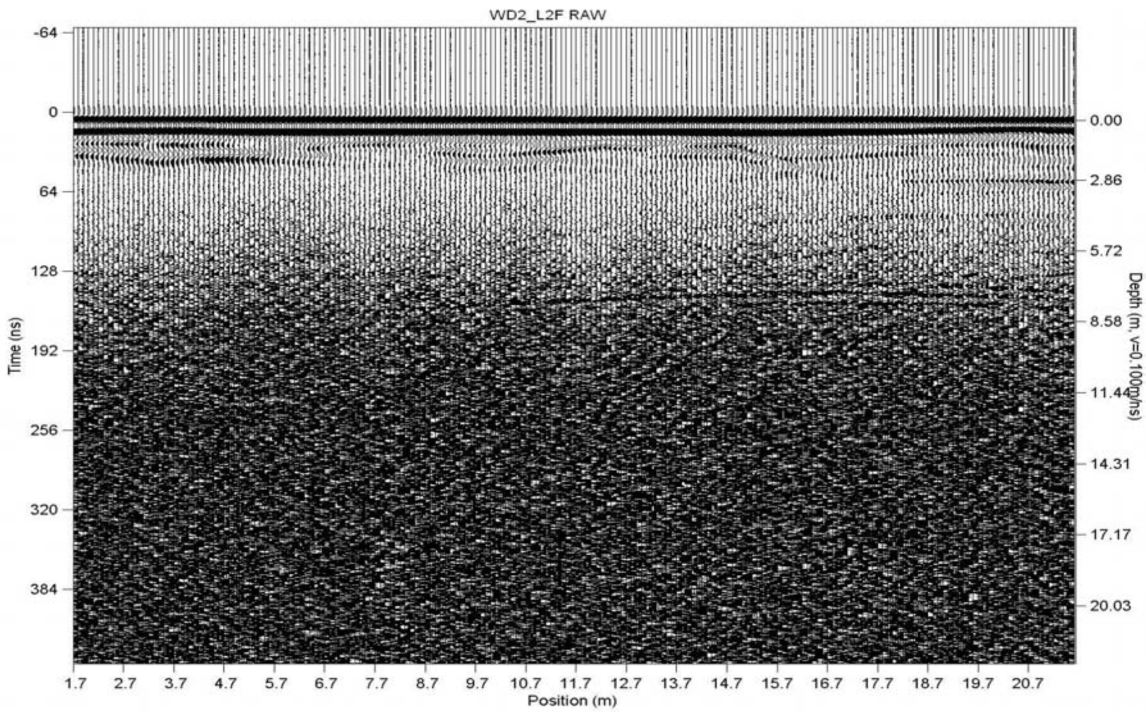


Figure 3.1a. Transect WD2_L2F Raw Data prior to any air wave removal.

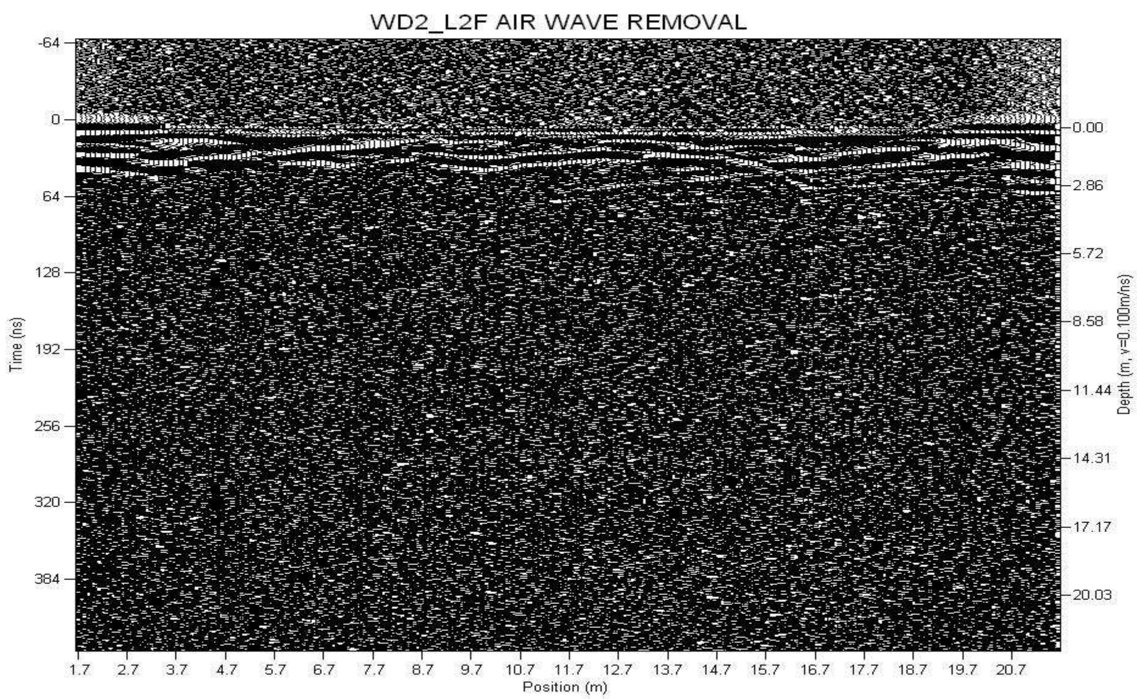


Figure 3.1b. Transect WD2_L2F after Sensoft Background Subtraction using 41 traces to average.

After completion of the air wave removal, the next step was to Repick Time Zero in which default parameters of +/-5% of the threshold value were used on all of the traces in order to readjust the time zero to a point where this value is first exceeded. Sensoft (2003), states that the Repick Time Zero procedure is used when the computer program set-up initially chooses the time zero incorrectly, the point that indicates the direct wave arrival. By using the Repick Time Zero routine a threshold value is chosen, which is a percentage of the peak amplitude value of the first trace. The first point to exceed this threshold value becomes the new time zero value (Sensoft, 2003). Once the Repick Time Zero was applied to all the transect data, the steps of gaining the data, using time filtering programs, the use of additional spatial filtering programs, and 2D migration were performed.

All of the available Sensoft gains were tested to evaluate how they affected the data. There were positives and negatives for most of the processes; a detailed description of all gains except the one chosen for processing is included in Appendix C. The gain of choice for processing was Automatic Gain Control (AGC) which attempts to equalize all signals by applying a gain that will strengthen the weaker signals more and the stronger signals less.
The AGC gain (using the settings of 0.1 for the window width and 10 for the gain maximum) was found to be the most effective with the main negative being the amplification of background noise along with reflection signal. The settings of window width and gain maximum help to limit how the gain is used. Sensoft (2003) states that the window width helps to regulate the area (window) around which an average signal level is calculated for each point, then the gain maximum helps to control the amount of gain applied to each point. The gaining of the background noise along with the reflector signal became a huge hindrance to those transects that were acquired through concrete or asphalt pads, because during data acquisition a constant gain

multiplier of 50 was applied to all transects. In looking at the raw data vs. the processed data for these transects, the raw data had already been gained and if gained another time during data processing the wave amplitudes in most cases tended to overlap one another. In the case of concrete or asphalt, the signal return was in most cases too amplified, the wave amplitudes again overlapped or bled into one another. Therefore, no additional gain was needed or beneficial during data processing. Figure 3.2 shows the same transect used previously, WD2_L2F but has the AGC applied. Figures 3.3a and 3.3b show BAND1 which is a transect through concrete, both a raw and processed version through the AGC step in the data processing procedure.

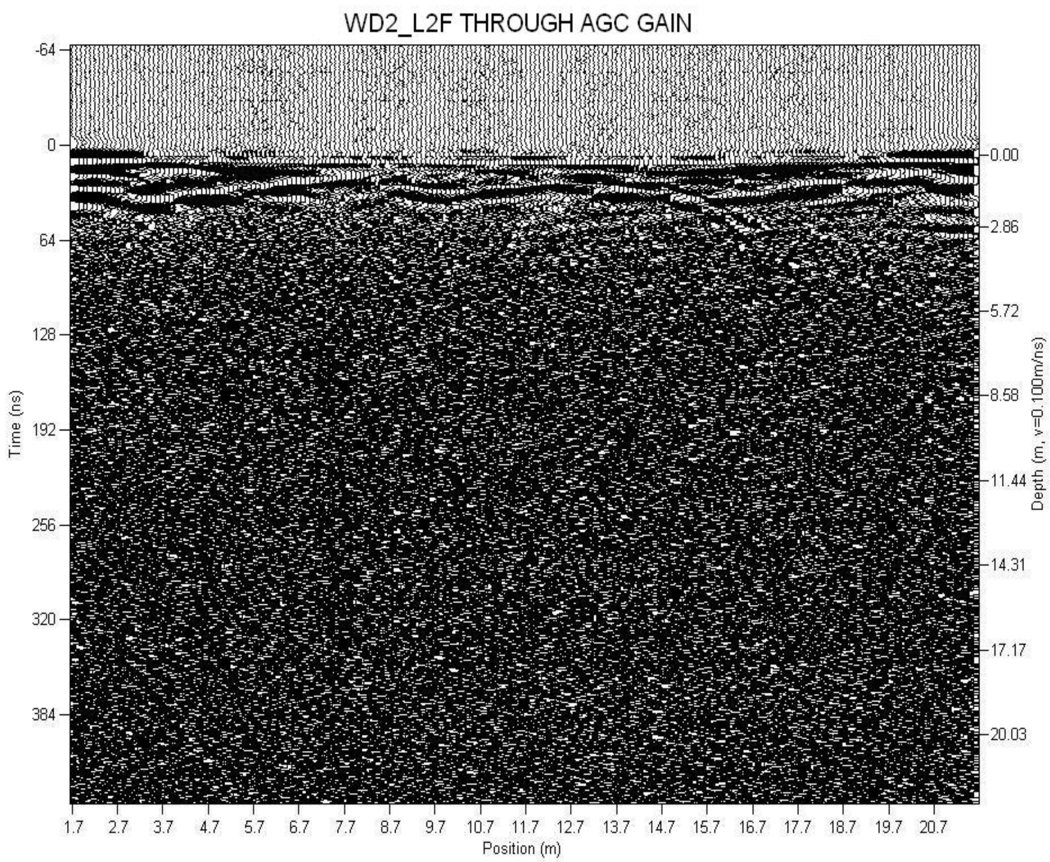


Figure 3.2. Transect WD2_L2F processed using DEWOW+Background Subtraction (averaging 41 traces)+AGC (using a window width of 0.1 and maximum gain of 10).

In comparing figures 3.3a to 3.3b the amplitudes of the wiggle traces tend to bleed into each other once the additional, AGC, gain is introduced into the processing of data. The difference between BAND1 and WD2_L2F is that since BAND1 is collected through a concrete pad which has sediments underneath that have been built up from normal ground surface with a retaining wall surrounding these sediments according to school blueprints (Appendix A), which creates a mounding affect as well as a cap to water infiltration, this allows for deeper signal penetration. In retrospect, the constant gain multiplier of 50 was too large for the dry soils/sediments in BAND1.

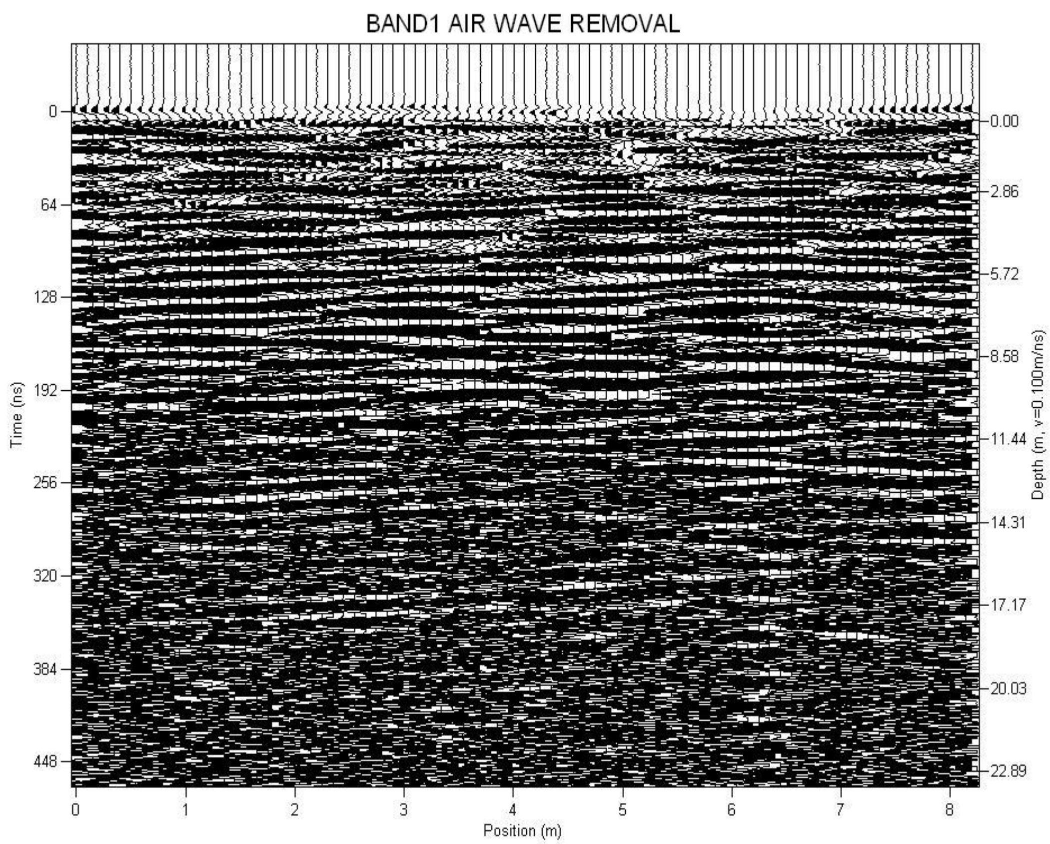


Figure 3.3a. Transect BAND1 processed using DEWOW+Background Subtraction (averaging 41 traces).

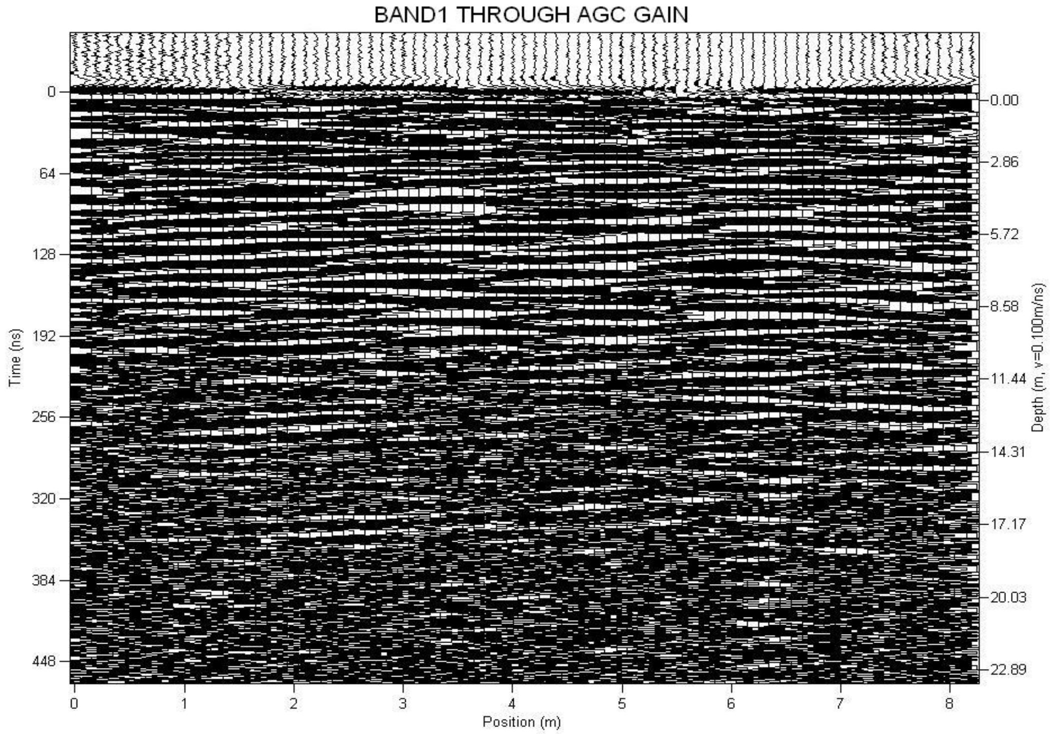


Figure 3.3b. Transect BAND1 processed using DEWOW+Background Subtraction (averaging 41 traces)+AGC (using a window width of 0.1 and maximum gain of 10).

Following the testing of the different gain processes, time filtering methods were applied to my data. Detailed description of all time filtering methods, except the one chosen for processing is included in Appendix C. The time filter of choice included the Band Pass Filter which uses the Fast Fourier transform trapezoidal procedure. When the BandPass filter was tested, the values used for the width of the trapezoid were based on review of the Average Amplitude Spectrum Plot that enables a view of all data frequencies for each individual transect and the corresponding amplitude at each frequency (Figure 3.4). Therefore, a different set of BandPass frequencies were chosen for each transect. In general, the frequencies were chosen to include the majority of the amplitude response, approximately 80%. This allows the inclusion of the greatest variety of frequencies in order to gain the best resolution possible, and increase the signal to noise ratio. A BandPass filter is structured much like a trapezoid in that the two top frequencies are the main ones of concern; however, on both limbs there is a gradual incline or decline to either reach or leave these main frequency values. Unless otherwise noted, the main corner frequency values are 0, 50, 300 and 350. Figure 3.4 is an Amplitude Spectrum Plot for transect WD2_L2F which shows what frequencies have the greatest amplitude response. By choosing a wide enough area of frequencies for the trapezoid, the signal tends to become more distinct and the noise filtered out. Figure 3.5 shows an example of how the trapezoid works and how the frequency values are arranged.

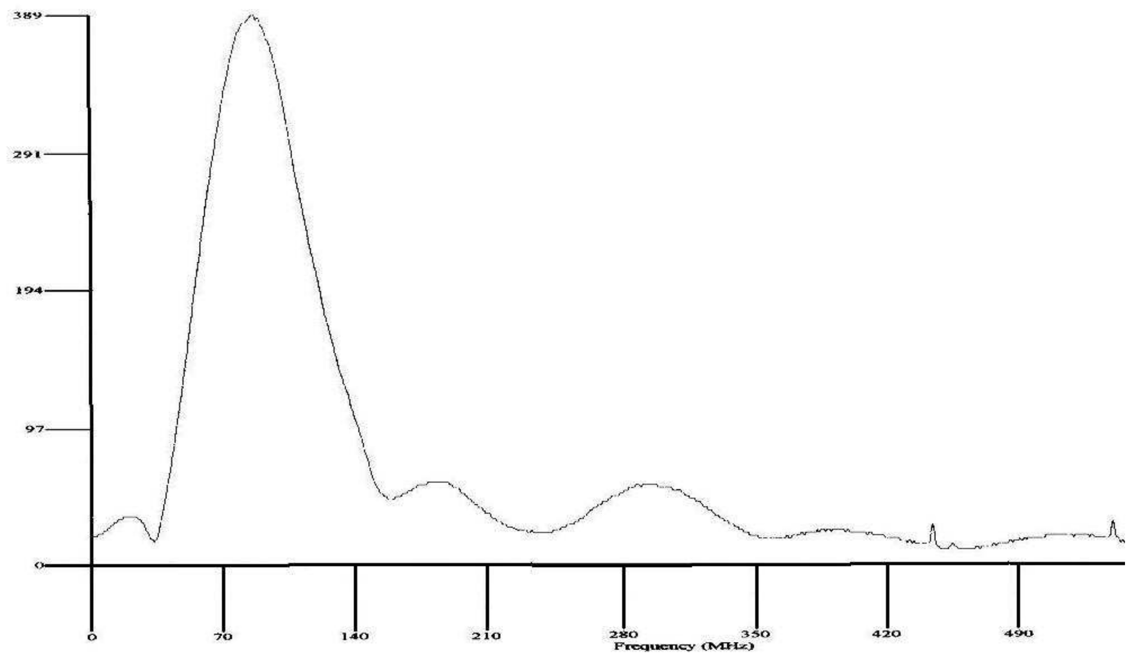


Figure 3.4. Average Amplitude Spectrum plot for transect WD2_L2F. Note where most of the amplitude response is in relation to frequencies.

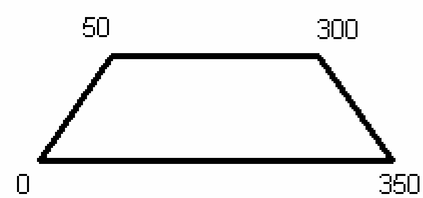


Figure 3.5. Trapezoid drawing of how the BandPass filter frequencies are arranged. The 50 and 300 values are the main values, this is where all the data will be included; however, in looking at the leg 0-50 or 300-350 the amount of inclusion drops off.

Values of 0, 40, 300 and 340 were used for two southern former Woodlawn High School (WD2_T13F and WD2_T13R) transects and the three inside WLKWY transects at Glen Oaks High School. Values of 0, 40, 360 and 400 were chosen for BAND1 and values of 0, 50, 320 and 360 were chosen for BAND2 for the former Woodlawn High School study area. The end result was that the BandPass filtering process both enhanced deeper reflectors, and increased continuity of some reflectors at both deep and shallow depths. This process filters out both low frequency, and high frequency noise. Figure 3.6 shows transect WD2_L2F after a BandPass Filter. The BandPass filter on Transect WD2_L2F brings out some deeper reflectors, at an approximate depth of 7 m that were not observed in the raw data.

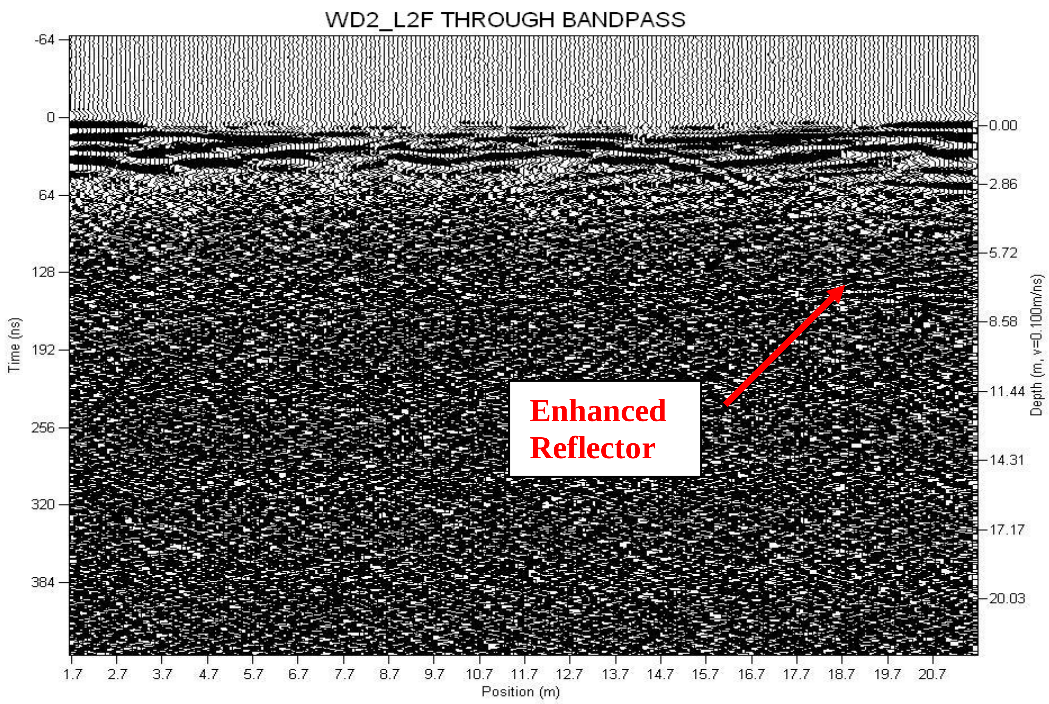


Figure 3.6. Transect WD2_L2F is processed using DEWOW+Background Subtraction (averaging 41 traces)+AGC (using a window width of 0.1 and maximum gain of 10)+BandPass filter (using frequencies of 0, 50, 300 and 350).

Following the time filtering processes, the spatial filter processes were tested on the same transect. Detailed description of all spatial filtering methods, except the one chosen for processing is included in Appendix C. The first spatial filter chosen again was the Background Subtraction, which was used and discussed at the beginning of processing to remove the air wave. The second spatial filter chosen was the Horizontal Filter which according to Sensoft, tends to emphasize flat lying or slowly dipping reflectors and suppresses rapidly dipping reflectors. The Horizontal process was tested, which according to Sensoft (2003) takes a running average across a dataset. Horizontal replaces each trace with an average trace produced by however many traces are chosen to be averaged. For example if trying to process trace 5, and the number of traces chosen is three, the program averages traces 4, 5, and 6 and replaces the original trace 5 value with the averaged value. This process works similarly to the SLP and SHP; however, it uses equal weighting to all the traces chosen. The default values chosen to be tested were 3 and 21 traces. When using 3 traces, the process smoothes out the data without taking the angled data out completely, and tends to increase the strength of the deeper reflectors. When using 21 traces, the process smoothes out all or most of the data completely. This process was chosen to be used, but with a value of 3 in order to help amplify or resolve the deeper signal response and to assist in making the shallower reflectors more coherent. Figure 3.7 shows processing of Transect WD2_L2F through the Horizontal spatial filter. Once the Horizontal spatial filter has been used, the deeper reflectors appear to be more amplified.

Following the spatial filtering processes, the 2D filters were tested. Detailed description of the 2D filtering methods not used for processing is included in Appendix C. The 2D filtering method chosen was the Migration Filter which according to Sensoft performs a synthetic aperture image reconstruction process to the data.

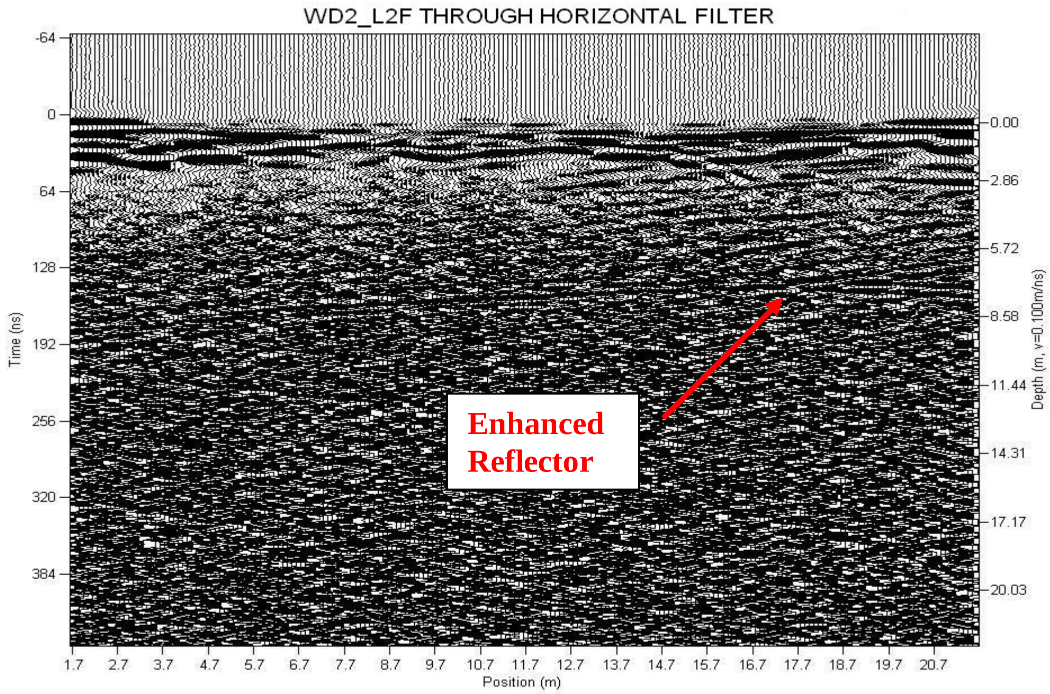


Figure 3.7. Transect WD2_L2F processed using DEWOW+Background Subtraction (averaging 41 traces)+AGC (using a window width of 0.1 and maximum gain of 10)+BandPass filter (using frequencies of 0, 50, 300 and 350)+Horizontal Filter (default setting of 3).

The Migration process was tested, which focuses scattered signals such as collapsing hyperbolic responses into a point response, or removing diffractions. The parameters needed for this filter include: velocity, spatial offset, and scale. The velocities used to test this process were 0.3 m/ns when dealing with air wave related reflectors, 0.06 m/ns for clays, 0.07 m/ns for silts, 0.10 m/ns for pavement and 0.15 m/ns for dry soils/sediments when dealing with the soil reflectors. The transects themselves already have a depth conversion velocity default of 0.1 m/ns along the right y axis in the Ekko_View viewing program. Since the majority of the transects were collected through concrete and or asphalt the default velocity value of 0.1 m/ns set in the Migration process was used during processing of data. However, a range of depths were calculated using each of the previously mentioned velocities. Also, the default values for spatial offset of 0 m and scale of 0.2 were not altered during processing. This process was chosen to be used for the remaining data processing because it tends to make the data more coherent. Figure 3.8 shows processing of Transect WD2_L2F through the final step 2-D Migration. In previous processing figures of Transect WD2_L2F a cross cutting reflector is observed at an approximate horizontal distance of 15.7 m; however, once the data has been 2-D Migrated using a velocity of 0.1 m/ns this cross cutting reflector is no longer observed.

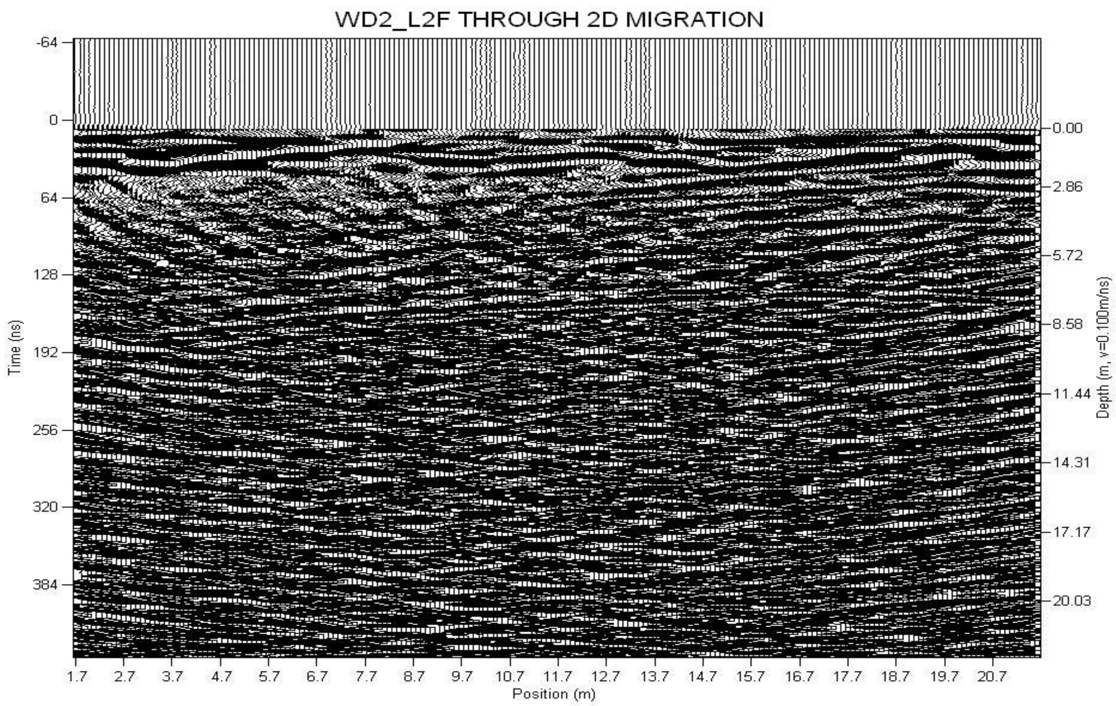


Figure 3.8. Transect WD2_L2F processed using DEWOW+Background Subtraction (averaging 41 traces)+AGC (using a window width of 0.1 and maximum gain of 10)+BandPass filter (using frequencies of 0, 50, 300 and 350)+Horizontal Filter (default setting of 3)+2-D Migration (using default values of 0.1 m/ns for velocity, 0 m for Spatial offset, and 0.2 for scale).

After the testing of each processing program was completed, a final recipe/combination of best operations was chosen. The final processing sequence is:

- DEWOW,
- Background Subtraction, number of traces chosen to be averaged is 41,

- Automatic Gain Control using a window width of 0.1 and a Gain Maximum of 10, when a gain is used,
- BandPass filter using corner frequencies of 0, 50, 300 and 350 for most transects processed; however, 0, 40, 300 and 340; 0, 40, 360 and 400; 0, 50, 320 and 360 are also corner frequencies that are used for the trapezoid,
- Horizontal, number of traces chosen to be averaged is 3, and
- Unless otherwise noted, the Migration process was used on each transect using a default velocity of 0.1m/ns since majority of transects were through concrete or asphalt. In some sections, an air wave migration was used with a velocity of 0.3m/ns, spatial offset of 0.0, and a scale of 0.2.

Also this new program has default calculations for determining depth of wave penetration using a default velocity of 0.1m/ns. In comparing the Sensoft depth of penetration calculations to the Excel Spreadsheet calculations by hand, the depths are similar in magnitude. As a result the Sensoft program calculations were used for the remaining data processing.

CHAPTER 4

FIELD METHODOLOGIES – VERTICAL ELEVATION DATA DIFFERENCING

4.1 Light Detection and Ranging

According to NASA's Light Detection and Ranging (LIDAR) tutorial, LIDAR uses the same principle as Radio Detection and Ranging (RADAR) which measures the strength of the returned electromagnetic signal. The LIDAR instrument transmits (infrared) light out to the target. The transmitted light then interacts with and is changed by the target it contacts. Some of this light is then reflected and scattered back to the instrument where it is analyzed. The time that it takes the light to travel to the target and back to the instrument is used to determine the distance to the target. According to LIDAR.com, LIDAR can measure distance, speed, rotation and chemical composition and concentration. The change in the properties of the transmitted light to the reflected light enables some properties of the target to be determined. There are three basic generic types of LIDAR: range finders, differential absorption LIDAR (DIAL), and Doppler LIDARs. Range finder LIDARs are the simplest and are used to measure the distance from the transmitter to a solid or hard target. DIAL is used to measure chemical concentrations and Doppler is used to measure velocities (wind velocities in particular). Additional information is available at http://www.ghcc.msfc.nasa.gov/sparcle/sparcle_tutorial.html and http://www.ghcc.msfc.nasa.gov/macaws. I compiled range finder LIDAR data in my field study areas.

The initial objective for this study's use of LIDAR was to locate data for either multiple seasons (i.e. dry vs. wet) or multiple years. From these data, I was planning on comparing them to the groundwater levels from USGS wells in order to determine whether there was an increase or decrease in groundwater levels for different years and groundwater's affect on movement on the Baton Rouge and/or Scotlandville faults. However, during inquiries to the LSU Department of Civil Engineering, the United States Geological Society (USGS) Center for Coastal and Watershed Studies, National Aeronautics and Space Administration (NASA) Airborne Oceanographic LIDAR Laboratory, Louisiana Geographic Information Center, Louisiana Oil Spill Coordinator's office, Louisiana Department of Transportation and Development (LADOTD), United States National Oceanic and Atmospheric Administration (NOAA), and the Louisiana Department of Environmental Protection (LADEP), it was determined that only one year (1999) of LIDAR data existed that covered my field study areas. Thus, LIDAR only serves as a pictorial representation of surface expressions of the faults, as well as provides a year of elevation data (Figure 4.1).

Figure 4.1 is an example of LIDAR and shows coverage in the area of the former Woodlawn High School field study area, obtained from the website http://www.atlas.lsu.edu (Louisiana Statewide GIS), year 1999. Additional and more detailed figures are included in Chapter 6, Results. The trends of both the Baton Rouge and Scotlandville Faults are visible in Chapter 6 figures. LIDAR observations in the area of the former Woodlawn High School show vertical elevations on the north side of the fault to be ~40 ft above MSL, and directly south of the fault line to be ~20 ft above MSL. The Glen Oaks High School field study area is higher in elevation compared to the Former Woodlawn High School. Observations in the area of the Glen Oaks High School show vertical elevations on the north side of the fault to be ~60 ft above MSL, and directly south of the fault line to be ~50 ft above MSL.

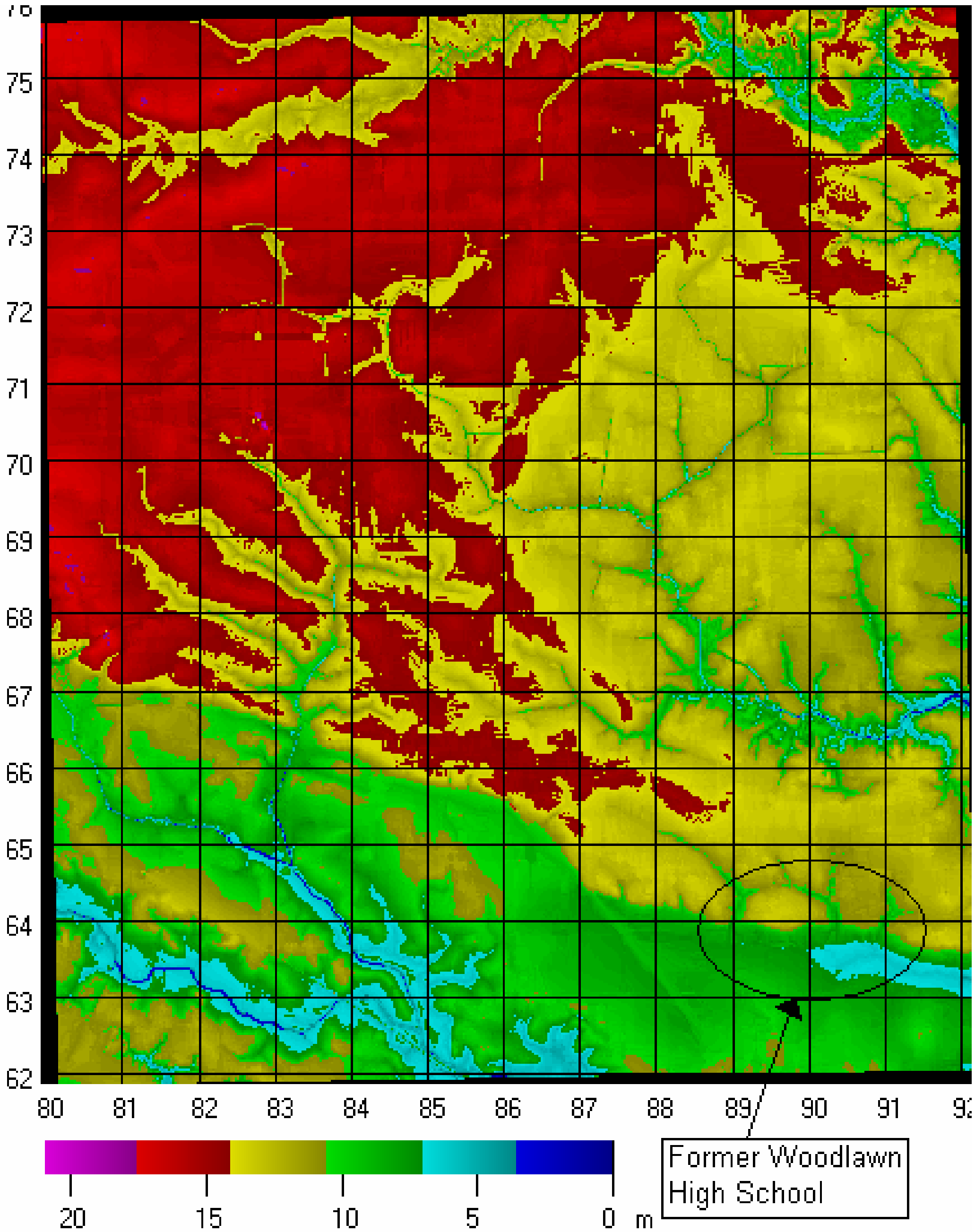


Figure 4.1 is an example of what LIDAR coverage looks like in the area of the former Woodlawn High School area.

4.2 Geodetic Leveling

The Geodetic technique that I have focused on for my research is Differential Leveling, which is the most accurate vertical leveling technique presently used (Burkard et al, 1983).

Within Differential Leveling, there are also levels/classes of accuracy with First Order First Class being the most accurate, First Order Second Class being less accurate, and Second Order First Class being the least accurate. Also, in cases when the Class is listed as Zero it means that the survey was completed based on earlier specifications that are less accurate in comparison to a First or Second Class measurement, regardless of Level designation (Kurt Shinkle, Personal Communication, 2005).

Collection of vertical elevation data includes the use of a measuring instrument (level) that is locked in position to which elevation readings are made on two calibrated staffs held upright, one ahead and one behind the instrument. The difference between the two measurements recorded is therefore the difference in elevation between each point. When starting a vertical leveling line, at least one point of exact vertical elevation (datum) must be known so that the remaining points measured can be computed by comparison (Burkard et al, 1983). Figure 4.2 is a recreation of a portion of Burkard et al's figure 14 which shows an example of the Differential Leveling, vertical elevation measurement, and technique.

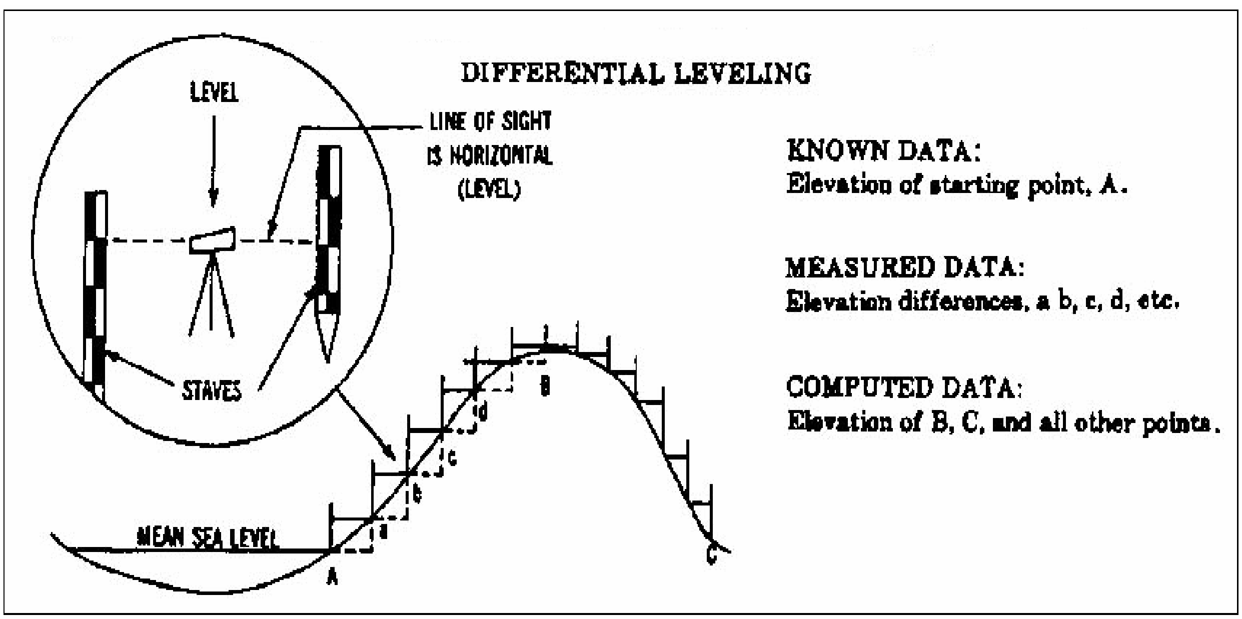


Figure 4.2. Schematic of Differential Leveling field data acquisition techniques.

During the course of tracking down Geodetic Leveling data for multiple years, I contacted multiple agencies/institutions. A detailed description and chain of events in tracking down, and constructing tables from this information is described in Appendix D. After several attempts through various individuals and agencies I was unable to acquire the National Geodetic Survey's raw geodetic leveling data.

My next course of action was to contact Mr. Cliff Mugnier with the LSU Department of Civil Engineering and Mr. Kurt Shinkle with NOAA/NGS. Mr. Mugnier was able to assist me in locating and reviewing the historical years of vertical and horizontal geodetic data available at the Army Corps of Engineers in New Orleans. During the review of these documents, it was clear that these data were not in a user friendly format (i.e. not electronic), and it was difficult to understand the individual benchmark geographic locations since the area maps were not up to date. After further conversations with Mr. Mugnier, it was clear that there has never been vertical elevation data that has been collected in the tight time frame (i.e. back to back months, seasons, or years) needed in order to compare with the hydrogeology data. In most cases releveling data are only collected every 10-20 years due to the high monetary costs of data collection.

Mr. Shinkle was able to provide me with 3 initial deliverables. The first deliverable was a listing of the benchmarks I chose and their corresponding 'Leveling Line Project/s' if applicable. The second deliverable was a 'Line List', which gave the title of the line project, where the line is located, the order and class of the levels (i.e. accuracy), and the year in which the line data was collected. The third deliverable was a NMO list, new minus old, which compared Lines of differing years, and the vertical elevation differences moving from the same benchmark to benchmark in each year. Of the Line projects able to be located with multiple years of data, the years covered were 1934, 1938, 1964, 1976, 1977, 1983, 1984, 1986 and 1987. These years covered were not available for every NMO comparison. The final deliverable was a Phase 1 for the lines that were used in the NMO comparisons, which provided unadjusted heights, and latitude and longitude for each benchmark included in the lines. Tables of the data provided to the NGS and the data they provided for the first 2 deliverables, and the data provided by the NGS for the NMOs available in the field study areas are included in Appendix D. All original data provided by NGS is included in Appendix E, including the remaining NMO comparisons as well as corresponding Level Line Phase I's.

CHAPTER 5

FIELD METHODOLOGIES – HYDROGEOLOGY

The aspect of hydrogeology that I focus on for my research is mainly on groundwater level elevations from the United States Geological Society (USGS) water wells that are located on either side of the fault near the GPR study areas. I tried to find wells in the field study areas that had multiple years of groundwater level data and were screened in one of the main groundwater supply aquifers for the East Baton Rouge Parish Area. Once I located these data, I then tried to compare the years of available groundwater elevation data to the years of NMO geodetic leveling data to see if they could be correlated. The reason for the comparison between the groundwater data and the Geodetic Leveling/LIDAR data is to determine if there is enough of a correlation between these values to determine if the faults form barrier to flow, and if groundwater withdrawal has influenced the movement along the faults.

I began my search by locating the USGS water well groundwater elevation data in the area of the field study sites. I found, through the USGS home page, a link to the website http://nwis.waterdata.usgs.gov/ la/nwis/gwlevels which provides groundwater levels and hydrographs for groundwater wells in Louisiana. I queried the website based on parish initially, and then paired the list down based on a latitude and longitudinal boxed area that would incorporate both field study areas and their surroundings. Through this website I was able to obtain the elevations measured for multiple years as well as hydrographs with these measurements plotted throughout time. Figures 6.76, 6.77 and 6.78 have been created which include the USGS well data, LIDAR data, and area Geodetic Leveling data; however, these are all included in Section VI, Results. Figure 6.76 shows both field study areas and their surroundings. Figures 6.77 and 6.78 are zoomed in versions of Figure 6.76 that show close ups of the field study areas, the LIDAR and Geodetic Leveling data in the direct vicinity, and the wells of interest in these areas. Using these zoomed in figures; I paired down my list of wells again to include only those wells that are in close proximity to the field study areas, and making sure to include wells on both sides of the faults in these areas. In order to make a determination as to whether these wells of interest were located in major or minor groundwater supply aquifers, I researched groundwater usage in the area of East Baton Rouge Parish; a complete detailed description of this research is included in Appendix F. A table that shows the wells in the area of the field study areas, their actual groundwater elevation data values for each year data are available in Appendix G and the well's corresponding hydrographs are included in Appendix H. Table 5.1 shows the years of groundwater elevation data available for the USGS wells in close proximity to the field study areas versus the years of available NMO Geodetic Leveling data and LIDAR data. This table shows the sparseness of the data available in each of the previously mentioned sources themselves, as well as the sparseness when trying to compare similar years of data between each different source.

Table 5.1
Years of Groundwater Elevations for USGS wells Near Field Study Areas vs. Years of NMO Geodetic Leveling and LIDAR Data

LAT	LONG	LOCATION	TD of well	Aquifer screened in	Years of data equivalent to NMO, and LIDAR	Years of addition al data	N-S of Fault
Wells near Former Woodlawn High School							
302345	910221	EB- 147	1078	1000 ft Sand	0	1937	N
302337	910101	EB- 192	468	400 ft Sand	1938	0	N
302308	910529	EB- 198C	1650	1200 ft Sand	0	1939	S
302515	910550	EB- 227	1300	1200 ft Sand	0	1917	N
302245	910115	EB- 255	350	Shallow Sands	0	1943	S
302235	910225	EB- 266	440	Shallow Sands	0	1994	S
302443	910436	EB- 274	1430	1200 ft Sand	0	1921	N
302439	910654	EB- 326	1480	1200 ft Sand	0	1936	S
302436	910438	EB- 400A	2741	2400 ft Sand	0	1947	S

Table 5.1 (Cont.)

LAT	LONG	LOCATION	TD of well	Aquifer screened in	Years of data equivalent to NMO, and LIDAR	Years of additional data	N-S of Fault
Wells near Former Woodlawn High School							
302436	910438	EB- 400B	3044	2800 ft Sand	0	1947	S
302436	910438	EB- 400C	2350	2000 ft Sand	0	1947	S
302313	910250	EB- 451	600	400 ft Sand	0	1993	S
302634	910222	EB- 584	1414	1200 ft Sand	0	1961	N
302553	910341	EB- 590	1441	1200 ft Sand	0	1956	N
302711	910255	EB- 591	1374	1200 ft Sand	0	1965	N
302500	910525	EB- 621	1487	1200 ft Sand	0	1957, 1990	N
302630	910318	EB- 622	1420	1200 ft Sand	0	1957	N
302330	910058	EB- 684	480	400 ft Sand	1984	1970, 1972, 1985	N
302304	910140	EB- 711	588	400 ft Sand	0	1950	S
302323	910045	EB- 721	687	400 ft Sand	0	1970, 1972, 1975	S
302606	910303	EB- 749	1403	1200 ft Sand	0	1962	N
302250	910212	EB- 760A	456	Shallow Sands	0	1963	S
302250	910212	EB- 760B	640	Shallow Sands	0	1970, 1972, 1975	S
302250	910212	EB- 761	644	400 ft Sand	0	1963, 1972	S
302306	910226	EB- 803A	1975	1500 ft Sand	1976, 1977, 1983, 1984, 1986	1966-1975, 1978-1982, 1985, 1990	S
302306	910226	EB- 803B	2565	2000 ft Sand	1976, 1977, 1983, 1984, 1986, 1987	1966-1975, 1978-1982, 1985, 1988-1990, 1992, 1996, 1997	S
302428	910350	EB- 804A	1950	1700 ft Sand	1976, 1977, 1983, 1984, 1986, 1987, 1999	1966-1975, 1978-1982, 1985, 1988-1998, 2000-2004	N
302428	910350	EB- 804B	2762	2400 ft Sand	1976, 1977, 1983, 1984, 1986, 1987, 1999	1966-1975, 1978-1982, 1985, 1988-1998, 2000-2004	N

Table 5.1 (Cont.)							
LAT	LONG	LOCATION	TD of well	Aquifer screened in	Years of data equivalent to NMO, and LIDAR	Years of additional data	N-S of Fault
Wells near Former Woodlawn High School							
302721	910547	EB- 878	2178	2000 ft Sand	0	1971, 2002	N
302402	910052	EB- 879	664	600 ft Sand	0	1972, 1990	N
302251	910212	EB- 894	519	Shallow Sands	1984	1975	S
302242	910215	EB- 982	540	Shallow Sands	1984	0	S
302509	910353	EB- 990	1450	1200 ft Sand	0	1990, 2001	N
302635	910222	EB-1003	1431	1200 ft Sand	0	2001	N
302320	910237	EB-1008	608	400 ft Sand	0	1978	S
302406	910212	EB-1017C	567	400 ft Sand	1984	0	N
302537	910328	EB-1025	2674	2400 ft Sand	0	2002	N
302518	910414	EB-1039	2697	2400 ft Sand	1984	0	N
302514	910554	EB-1136	1405	1200 ft Sand	1977	0	N
302358	910219	EB-1163	465	400 ft Sand	1987	0	N
302317	910236	EB-1219	620	400 ft Sand	0	1990	S
302317	910232	EB-1244	620	400 ft Sand	0	1985	S
302522	910419	EB-1287	1510	1200 ft Sand	0	1998	N
302405	910219	EB-1295	1820	1500 ft Sand	1999	0	N
302521	910417	EB-1297	1635	1200 ft Sand	1999	0	N
Wells near Glen Oaks High School							
302747	910930	EB- 84	1590	1500 ft Sand	0	1927, 1943-1945	S
302751	910932	EB- 86B	2186	2000 ft Sand	0	1943, 1944, 1945	S
302750	910926	EB- 88	2142	2000 ft Sand	0	1943, 1944, 1945	S
302751	910925	EB- 89	1605	1500 ft Sand	0	1927, 1943-1945, 1947-1950	S
302746	910916	EB- 94	1595	1500 ft Sand	0	1940, 1943-1945, 1958-1960	S
302957	910851	EB- 105	1464	1500 ft Sand	0	1921	S

Table 5.1 (Cont.)

LAT	LONG	LOCATION	TD of well	Aquifer screened in	Years of data equivalent to NMO, and LIDAR	Years of additional data	N-S of Fault
Wells near Glen Oaks High School							
302756	910921	EB- 121	1570	1500 ft Sand	0	1920	S
302750	910915	EB- 133	2553	2000 ft Sand	0	1944	S
302852	910617	EB- 135	1429	1500 ft Sand	1938	0	S
302848	910924	EB-153	1562	1500 ft Sand	0	1919	S
302908	910931	EB- 154	2474	2400 ft Sand	0	1942	S
302927	910517	EB-307	1161	1200 ft Sand	0	1926, 1943-1945, 1947, 1948, 1956, 1959	S
302842	910638	EB- 308	1170	1200 ft Sand	0	1915, 1943-1945	S
302934	910854	EB- 312	1370	1500 ft Sand	0	1925, 1943-1953	N
303102	910810	EB- 315	1960	2000 ft Sand	1938	1939-1956	N
302820	910724	EB- 327	1236	1200 ft Sand	1976, 1977, 1983, 1986, 1987, 1999	1972-1975, 1978-1982, 1984-1985, 1988, 1990, 1992-1998, 2000-2003	S
302842	910608	EB- 328	1340	1200 ft Sand	0	1939	S
303131	910724	EB- 342	1140	1200 ft Sand	0	1937	N
303134	910746	EB- 343	1120	1200 ft Sand	0	1959	N
303122	910844	EB- 344	385	400 ft Sand	0	1944	N
302854	910546	EB- 348	1430	1500 ft Sand	0	1939	S
302854	910546	EB- 349	1130	1200 ft Sand	0	1935	S
303126	910836	EB- 373	1370	1500 ft Sand	0	1944	N
303052	910919	EB- 374	1409	1500 ft Sand	0	1949	N
302958	910856	EB- 378	2777	2800 ft Sand	0	1953, 1959, 1972	S
303137	910812	EB- 399	294	400 ft Sand	1984	1956, 1973-1975	N
303137	910728	EB- 420	292	400 ft Sand	0	1951	N
302957	910851	EB- 443	1462	1500 ft Sand	0	1946	S

Table 5.1 (Cont.)							
LAT	LONG	LOCATION	TD of well	Aquifer screened in	Years of data equivalent to NMO, and LIDAR	Years of additional data	N-S of Fault
Wells near Glen Oaks High School							
302902	910922	EB- 447	1600	1500 ft Sand	0	1947	S
303102	910810	EB- 455	1165	1200 ft Sand	0	1947	N
303032	910820	EB- 462	398	400 ft Sand	0	1947	S
302845	910814	EB- 514B	2595	2400 ft Sand	0	1954-1955	S
303021	910800	EB- 523	1206	1200 ft Sand	0	1959, 2001	S
303032	910820	EB- 524	384	400 ft Sand	0	1951	S
303019	910748	EB- 653	1153	1200 ft Sand	0	1963	S
303021	910748	EB- 654	2382	2400 ft Sand	0	1958	S
303130	910731	EB- 700	2557	2800 ft Sand	0	1970, 1990	N
303018	910756	EB- 718	2380	2400 ft Sand	0	1961	S
302716	910838	EB- 751	2595	2400 ft Sand	0	1962, 2000	S
303019	910737	EB- 756	1168	1200 ft Sand	0	1962, 1990	S
303021	910737	EB- 769	2362	2400 ft Sand	0	1963, 2002	S
302718	910839	EB- 774	2143	2000 ft Sand	1964	1992, 2002	S
303135	910705	EB- 779	304	400 ft Sand	0	1965	N
303023	910756	EB- 826	350	400 ft Sand	1976, 1977, 1983, 1984, 1986, 1987	1967-1975, 1978-1982, 1985, 1988	S
302721	910548	EB- 873	1884	1700 ft Sand	0	2003	S
302731	910547	EB- 878	2178	2000 ft Sand	0	1971, 2002	S
302717	910839	EB- 927	1511	1500 ft Sand	0	1974, 2001, 2003	S
303018	910756	EB- 928	2375	2400 ft Sand	0	1974, 2002	S
302955	910606	EB- 933	603	600 ft Sand	1976, 1977, 1983, 1984, 1986, 1987, 1999	1974-1975, 1978-1982, 1985, 1988-1998, 2000-2004	S

Table 5.1 (Cont.)							
LAT	LONG	LOCATION	TD of well	Aquifer screened in	Years of data equivalent to NMO, and LIDAR	Years of additional data	N-S of Fault
Wells near Glen Oaks High School							
302955	910605	EB- 934	385	400 ft Sand	1976, 1977, 1983, 1984, 1986, 1987, 1999	1974-1975, 1978-1982, 1985, 1988-1998, 2000-2004	S
302717	910514	EB- 961	1541	1500 ft Sand	0	1975, 1990, 2001, 2003	S
303133	910837	EB-1091	36	Shallow Sands	0	1985	N
303031	910834	EB-1206	410	400 ft Sand	1984	0	S
302824	910540	EB-1303	1707	1700 ft Sand	0	2000	S

CHAPTER 6

RESULTS

6.1. GPR Data Results for The Former Woodlawn High School

A total of 18 transects of GPR data were collected at the former Woodlawn High School. These transects were concentrated both around and inside the Band Room/Auditorium complex on the western side of the school property. Figure 6.1 is a topographic map showing the location and orientations of the building in the study area. The transects were concentrated in this area of the property because of the distinct visual structural damage observed at ground surface in the onsite buildings and driveways. Figures 6.2 through 6.9 are photographs of the property tracing the structural damage from the west outside building wall of the Band Room to the outside parking lot area, east of the Auditorium.

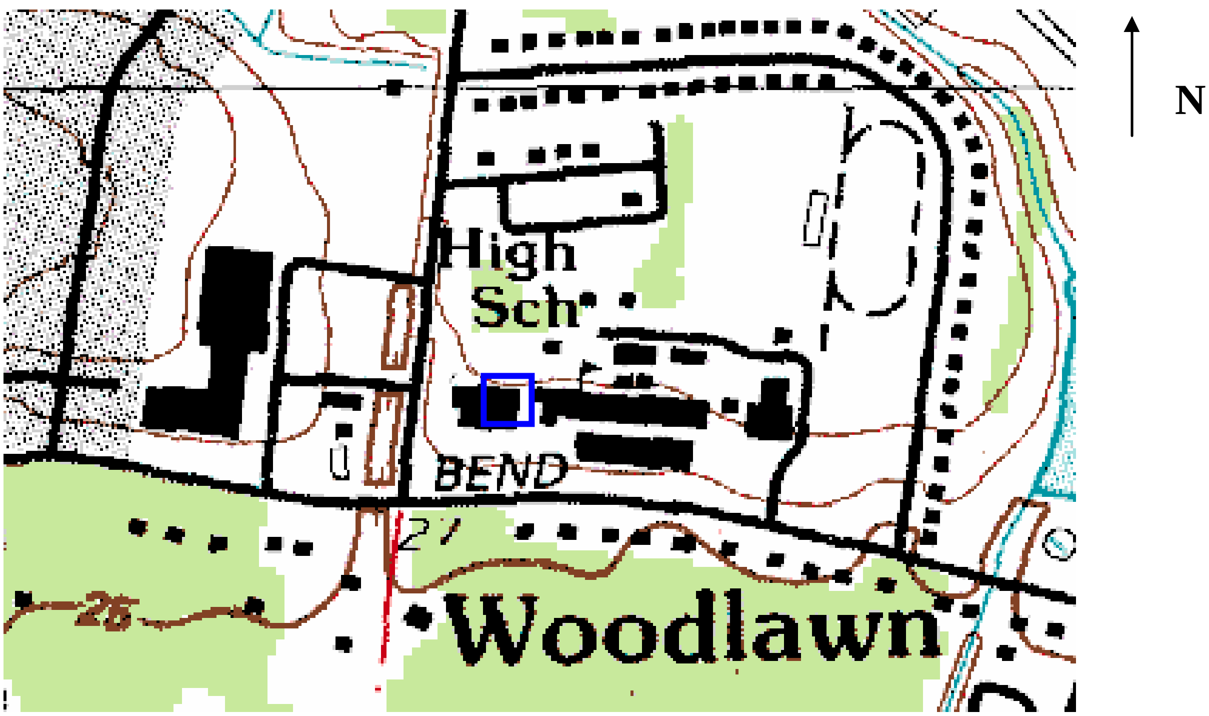
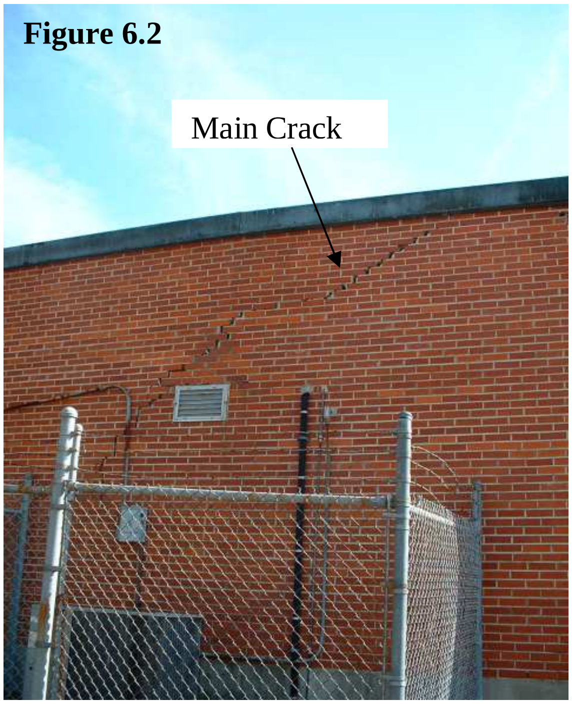
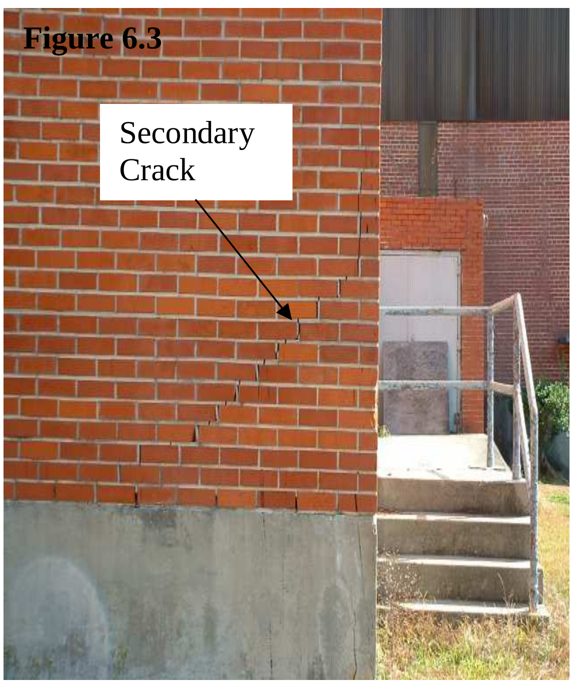
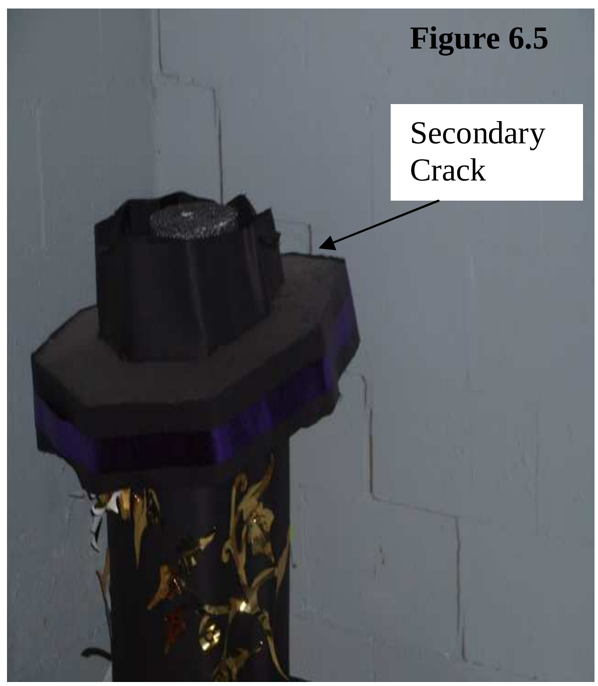


Figure 6.1. Zoomed in version of the topographic map. The area in blue is the Band Room/Auditorium complex. Scale is 1" measured equals 800 ft on the ground.

North South South North







Figures 6.2 and 6.3 are of the west outside wall of the Band Room. Figure 6.2 is the main crack in the wall, and Figure 6.3 is the secondary crack in the wall. Figures 6.4 and 6.5 are of the same wall but from the inside of the Band Room. Figure 6.4 shows the offset due to fault movement and Figure 6.5 is the secondary crack.

North South South North

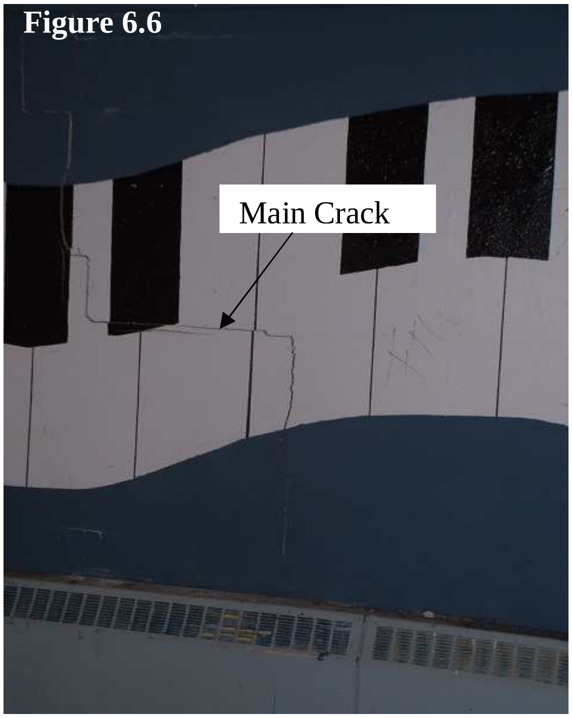


Figure 6.6

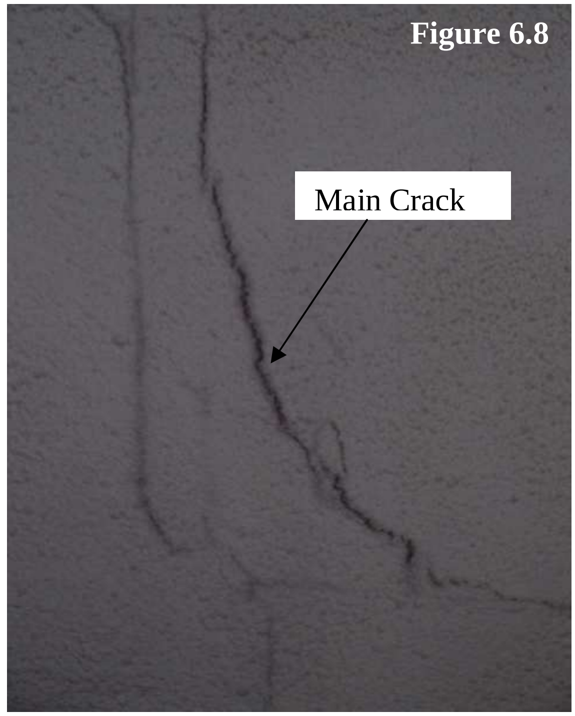


Figure 6.8

Figure 6.7

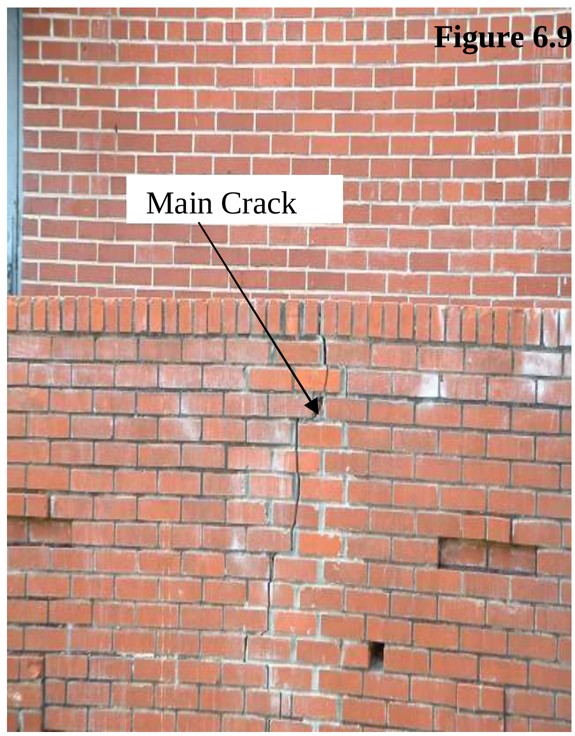


Figure 6.9

Figures 6.6 and 6.8 are interior building pictures. Figure 6.6 is the main crack inside the east wall of the Band Room; Figure 6.8 is the main crack inside the west wall of the Auditorium. Figures 6.7 and 6.9 are exterior pictures of the main crack, east of the Auditorium. Figure 6.9 shows a retaining wall east of the Auditorium and Figure 6.7 is of the parking lot and curb to the east of the Auditorium.

According to historical observations and reports in this area of East Baton Rouge Parish, these surficial structural damage features are a result of movement along the Baton Rouge Fault. Figure 6.10 shows the orientation of each GPR transect both surrounding and within the Band Room/Auditorium complex. For this field study area, the GPR transects completed are subdivided into four areas as shown in Figure 6.10: the red area to the west of the Band Room and perpendicular to the fault trend; the yellow area to the south of the Band Room and parallel to the fault trend; the blue area inside the Band Room and perpendicular to the fault trend; and the green area between the Band Room/Auditorium building complex and are perpendicular to fault trend (Figure 6.10).

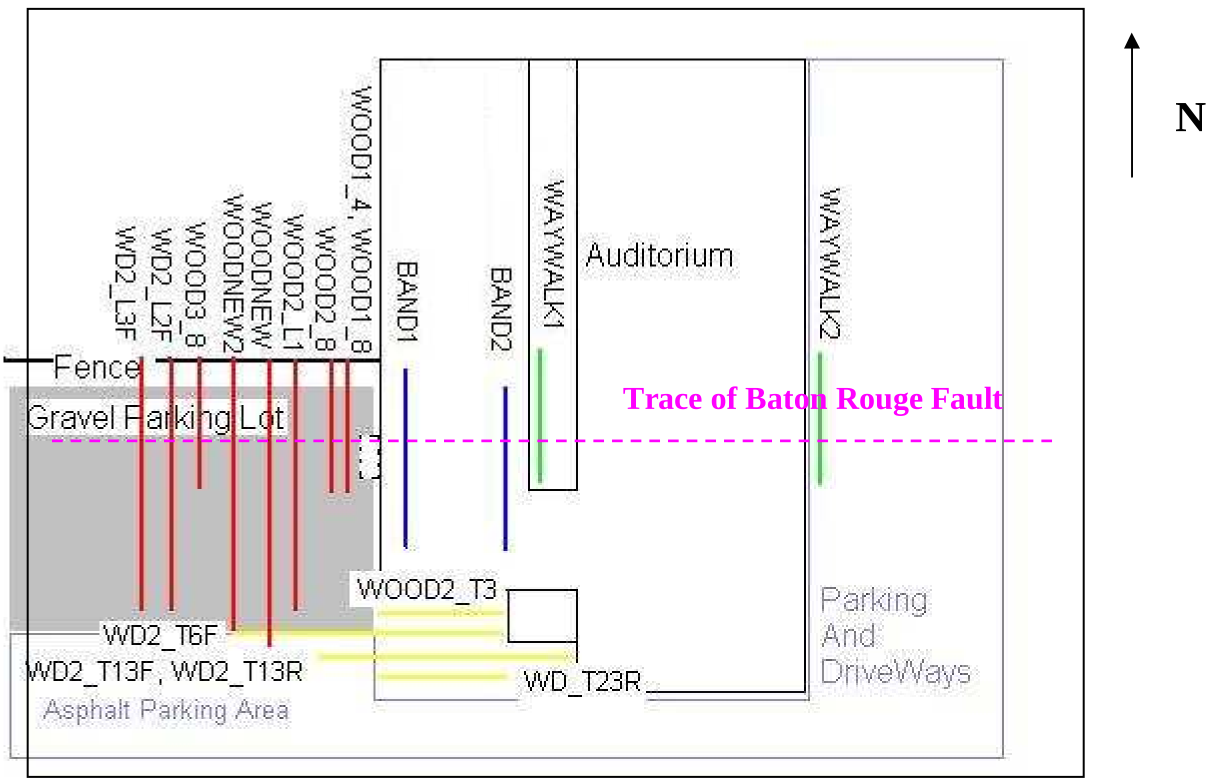


Figure 6.10. Site Map of former Woodlawn High School Field Study Area. North is to the top of the page.

The following sections describe in detail what observations can be made from viewing the raw data and the processed data both as two way travel time (TWTT) and depth. The depth has been calculated by the Sensoft data acquisition program, PulseEKKO 100 based upon an assigned velocity. The default velocity setting of 0.1 m/ns which is typical for pavement, concrete, wet rock, and close to limestone/dry rock/dry salt/granite/dry sand/ and dry soil was used in data acquisition. A table showing the depth conversions of field study areas based on different velocities including those for dry soil (0.15 m/ns), silts (0.07 m/ns), and clays/wet soils (0.06 m/ns) is included in Appendix I. For descriptive purposes and because most of the transects were collected through asphalt or concrete, the 0.1 m/ns velocity was used when determining the depth to reflectors. No borings or trenches exist in the area of the former Woodlawn High School to give a direct reference to the depths to soils horizons, so an exact determination of depth to reflectors cannot be calculated.

For each GPR transect, interpretations were made both in the raw and processed data. Each geologic feature, such as a fault or offset has been color coded to be correlated both between the raw vs. the processed versions of the transect itself as well as comparing between different transects. The color coding allows for correlation spatially within the individual transect and between transects.

The following sections deal with the red area which includes the following transects starting with those adjacent to the western Band room wall: WOOD1_4/WOOD1_8, WOOD2_8, WOOD2_L1, WOODNEW, WOODNEW2, WOOD3_8, WD2_L2F, WD2_L3F. These sections only focus on transects WOOD1_4/WOOD1_8, WOOD2_8, and WOODNEW, the remaining transects are discussed in detail in Appendix J. Each of these transects were processed as described in Chapter III, Data Processing Methodologies. Once the data has been processed both features observed in the raw data as well as additional ones are revealed. Comparisons between each of these transects were made to determine where the true geologic reflector data ended in order to crop the data. The result was to crop all transects to a TWTT of approximately 165 ns, which in some of the transects still shows some deeper noise or multiples in the data. However, overall the cropped data concentrates on just the real geologic reflector data observed. When reviewing the transect data below an approximate maximum TWTT of 165 ns, in many cases TWTT is smaller, the data appears to be overwhelmed with noise and there is little to no coherence in the data. However, there are some angled reflectors that appear to be an artifact, such as multiples, that are not a result of soil geology.

6.1.1 Transects WOOD1_4 and WOOD1_8

Transects WOOD1_4 and WOOD1_8 are parallel and immediately adjacent to the west Band Room Wall (Figure 6.10). Transect WOOD1_4 was originally set up to be collected for a total distance of 27.4 m; however, due to problems with the data acquisition process, traces were skipped and only the first 10.1 m were collected. I first tried to perform a 'Data Gap' fill during data processing in order to fill in missed traces due to speed of data collection; however, the process only added dummy lines from 10.1 m to 27.4 m. Because of this it was determined that traces were not missed as a result of speed of acquisition, but rather there were problems with the actual data acquisition equipment so that data was no longer being collected/recorded past 10.1 m. Once this problem was found, it was determined that all processing and evaluation on this transect would only be for the distance data was acquired, 10.1 m. Transect WOOD1_4 was collected using a stacking setting of 4 stacks, transect WOOD1_8 is the same transect; however, the stacking used was 8 stacks.

Transect WOOD1_8 was originally set up to be collected for a total distance of 10.1 m. However, due to problems some traces were missed. The problems encountered were that traces were missed/skipped or not recorded by the GPR equipment while using the antenna cart and odometer equipment. As a result, I performed a 'Data Gap' fill during processing to fill in the two missed traces.

The reflections shown in the Ekko_View imaging program for these transects appear to be received from ground surface to an approximate TWTT of 121.2 ns, or a depth of 6.06 m, using a velocity of 0.1 m/ns, the depth would be between 3.64 m and 4.24 m for a velocity of 0.06 m/ns or 0.07 m/ns.

Figures 6.11a and 6.11b are Wiggle Trace views of the raw data for WOOD1_4 and WOOD1_8 respectively, which shows relatively horizontal reflectors at shallow depths, from ground surface to an approximate TWTT of 54.8 ns, or to a depth of 2.74 m, and four bedding offsets dipping towards the south. Figures 6.12a and 6.12b are the same transects WOOD1_4 and WOOD1_8, but they are in a processed Wiggle Trace view which shows a bowl shaped feature and six bedding offsets dipping towards the south.

When comparing the raw data for transects WOOD1_4 and WOOD1_8 in both instances there are four faint offsets in bedding observed at shallow depths, from ground surface to an approximate TWTT of 57.2 ns, or a depth of 2.86 m bgs, and at horizontal distances of 4m, 5.5 m, 7 m and 8 m respectively. These four offsets are outlined in figures 6.11 and 6.12 a and b in green, blue, purple pink and yellow respectively. In both processed transects a bowl shaped feature is observed spanning the entire length of the transects starting at an approximate TWTT of 28.5 ns to a maximum TWTT of 57.2 ns, or a depth of 1.43 m to a maximum depth of just greater then 2.86 m, and are marked in Figures 6.12 a and b in red. There are two additional shallow offsets observed in the processed data, and are located north of those observed in the raw data. The additional shallow offsets are located at horizontal distances of 2 m and 3 m respectively, and are outlined in Figures 6.12 a and b in light pink and yellow respectively.

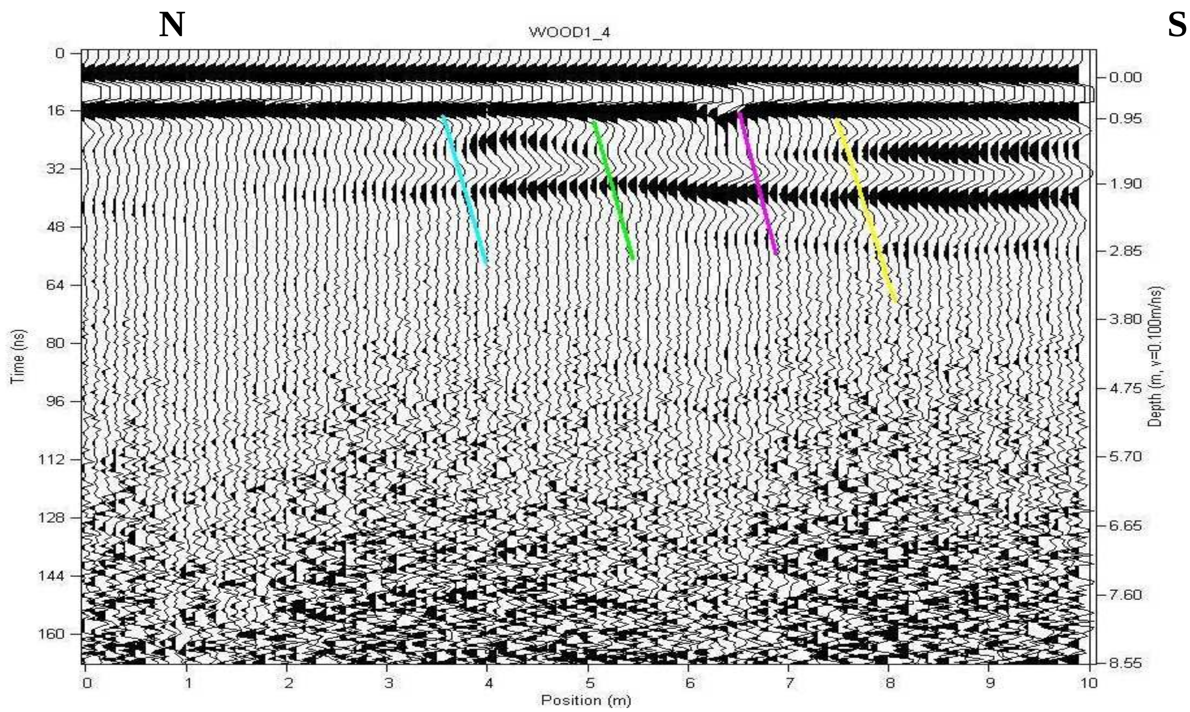


Figure 6.11a. WOOD1_4 Raw Data. The blue, green, purple pink and yellow lines denote offsets of beds.

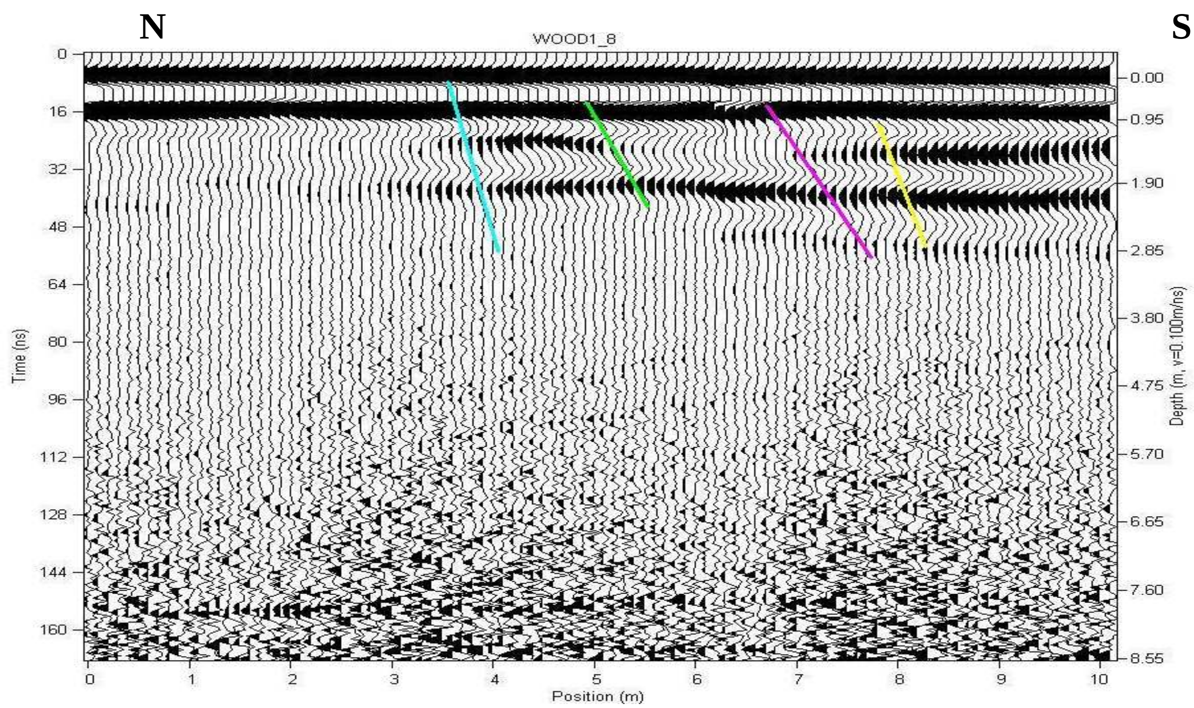


Figure 6.11b. WOOD1_8 Raw Data. The blue, green, purple pink and yellow lines denote offsets of beds.

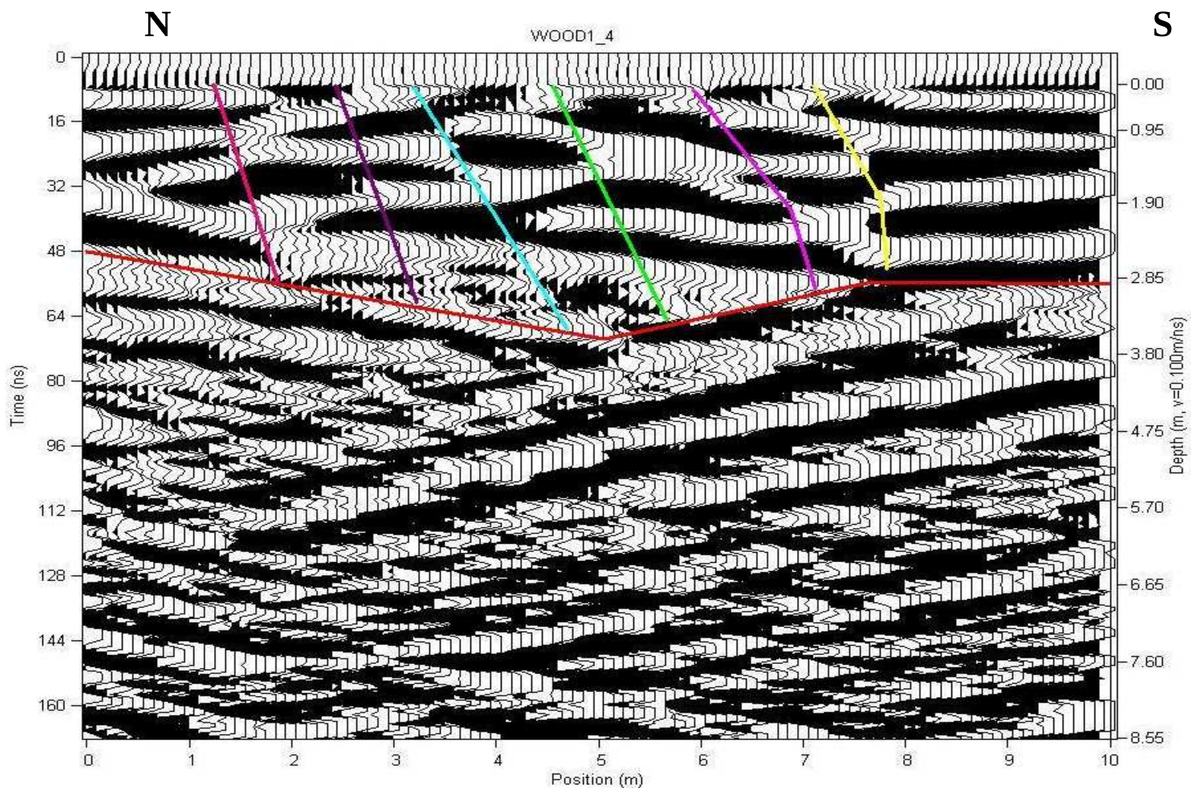


Figure 6.12a. WOOD1_4 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green and yellow denote offsets of beds.

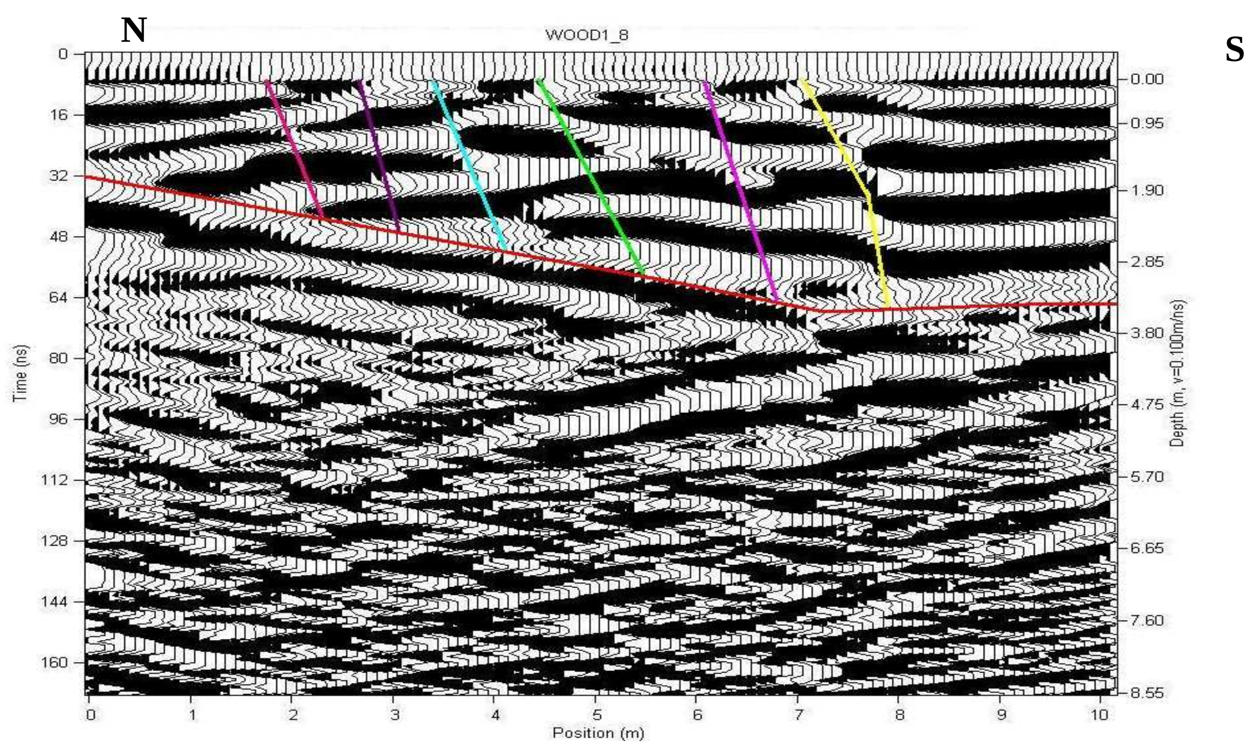


Figure 6.12b. WOOD1_8 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green and yellow denote offsets of beds.

6.1.2 Transect WOOD2_8

Transect WOOD2_8 is parallel to the west Band Room Wall, and is between transects WOOD1_4/1_8 and WOOD2_L1 (Figure 6.10). The reflections shown in the Ekko_View imaging program for this transect appear to be received from ground surface to an approximate TWTT of 85.5 ns, or a depth of 4.29 m, using a velocity of 0.1 m/ns, the depth would be between 2.57 m and 3.0 m if soil velocity is 0.06 m/ns or 0.07 m/ns. Figure 6.13 is a Wiggle Trace view of the raw WOOD2_8 transect data which shows relatively horizontal reflectors at shallow depths, from ground surface to TWTT of 28.5 ns or 1.43 m depth, a graben like feature that extends from approximately 0.72 m, or TWTT of 14.4 ns, to a maximum depth of 4.29 m, or TWTT of 85.5 ns, and three bedding offsets dipping towards the south and one dipping towards the north. Figures 6.14 is the same transect WOOD2_8, but is a processed Wiggle Trace view which shows a bowl shaped feature and seven bedding offsets, four dipping towards the south and three that are faintly dipping towards the north.

There are four faint offsets in bedding observed in the raw data at shallow depths, and at horizontal distances of 1.5 m, 2.5 m, 5 m, and 6.5 m in Figure 6.13 in two pinks, purple and green respectively. As in the previous transects, a bowl shaped feature is observed spanning the entire length of the transect and is marked in Figure 6.13 in red. There are three additional shallow offsets observed in the processed data that are located at horizontal distances of 3.5 m, 7.5 m, and 8.5 m, and are outlined in Figure 6.13 in blue, yellow and orange respectively.

6.1.3 Transect WOODNEW

Transect WOODNEW is parallel to the west Band Room Wall, and between transects WOOD2_L1 and WOODNEW2 (Figure 6.10). The reflections shown in the Ekko_View imaging program for this transect appear to be received from ground surface to a TWTT of 218.8

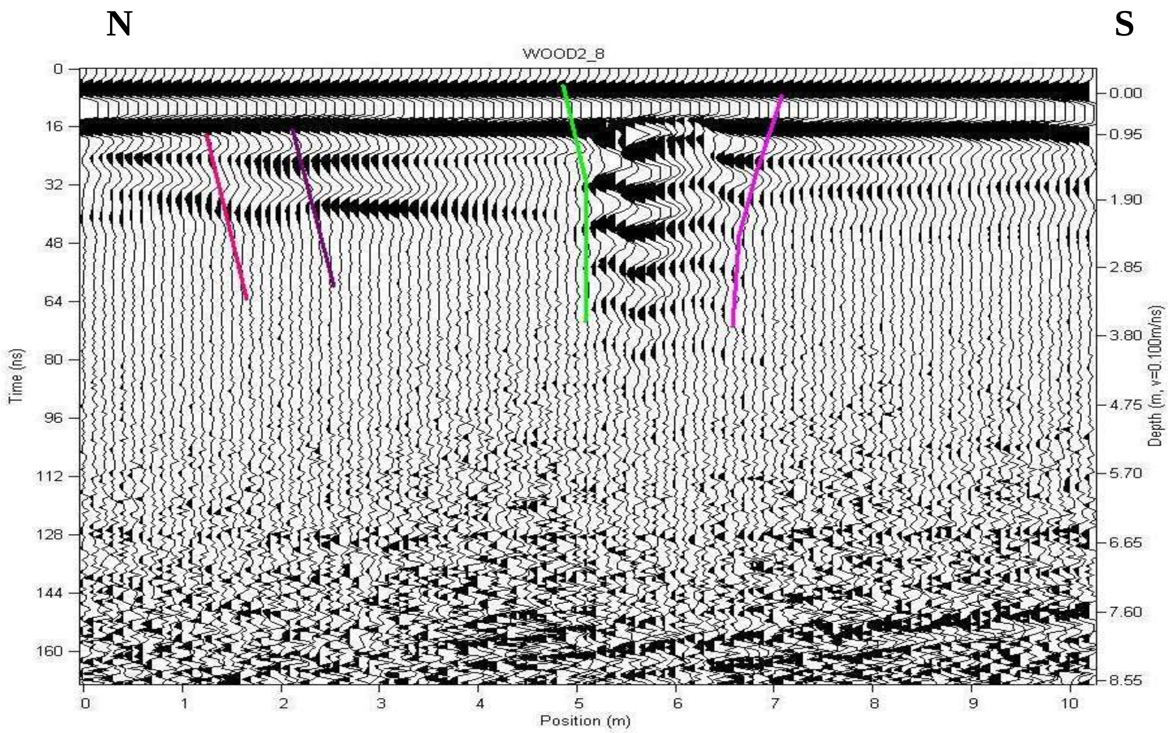


Figure 6.13. WOOD2_8 Raw Data. The two pink, purple, and green lines denote offsets of beds.

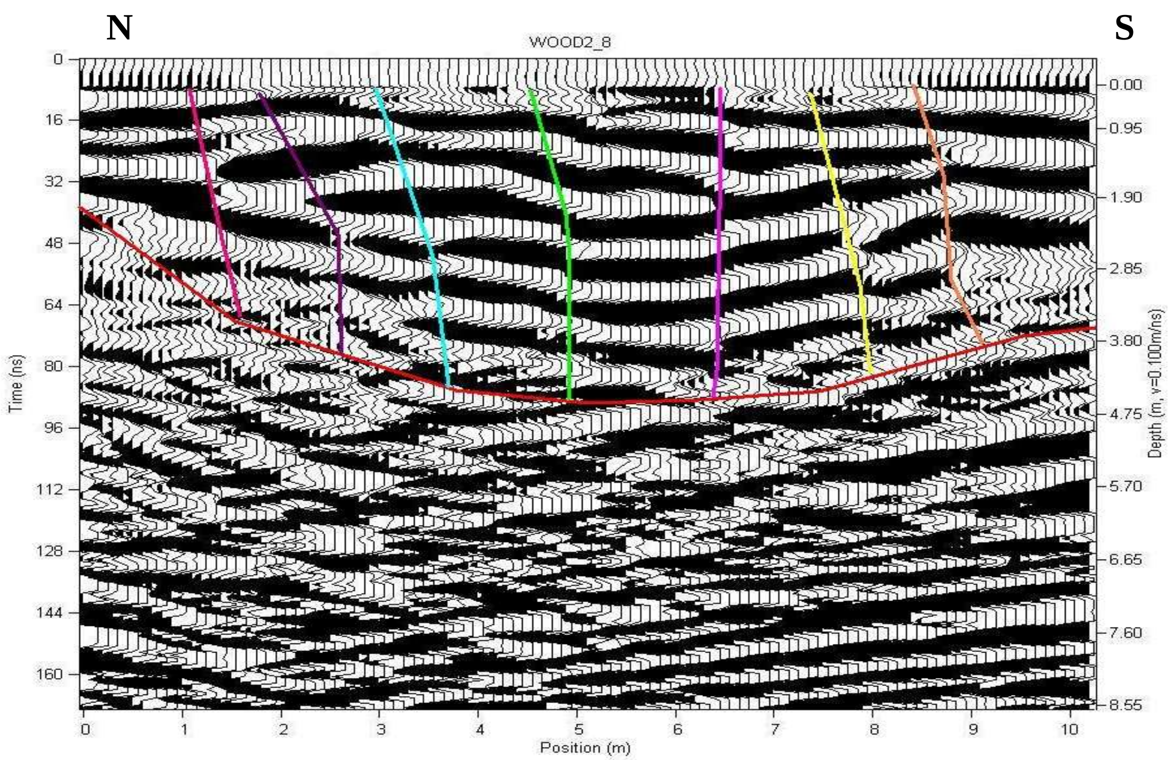


Figure 6.14. Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green, yellow and orange lines denote offsets of beds.

ns, or a depth of 10.94 m, using a velocity of 0.1 m/ns, the would be between 6.56 m and 7.66 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure 6.15 is a Wiggle Trace view of the raw WOODNEW transect data which shows relatively horizontal reflectors from ground surface to approximately 10.94 m and seven faint offsets in bedding at shallow depths. Figure 6.16 is the same transect WOODNEW, but is a processed Wiggle Trace view which shows several reflected features and a cross over feature.

There are five faint offsets in bedding observed in the raw data at shallow depths from a minimum depth of 0.8 m, TWTT of 16 ns, to a maximum depth of 5.72 m, TWTT of 114.4 ns. The offsets are located at horizontal distances of 3.5 m, 4 m, 5.5 m, 9 m, 17 m, 19 m and 20.5 m and are outlined in Figure 6.15 in purple, blue, green, purple pink, olive, cream and brown respectively. Once processed again the data reveals a bowl shaped feature that spans the entire length of the transect and is marked in Figure 6.16 in red. There are four more shallow offsets observed in the processed data that are located at horizontal distances of 1.5 m, 11 m, 13 m and 16 m, and are outlined in Figure 6.16 in light pink, yellow, orange and royal blue respectively.

There are also some cross over features that appear in both shallow and deeper depths that are an artifact that is not a result of soil geology, possibly ground surface interference. These crossovers are observed at horizontal distances of 17 m and 19-20 m and are outlined by a bright orange 'X' in Figure 6.16. A crossover or bowtie feature can be a result of the air wave reflecting off of objects at the ground surface (Sun et al., 1995). The main suggestion to remove such an affect is to migrate the data using the air wave velocity, 0.3 m/ns. Initially the data is processed and migrated using the 0.1 m/ns velocity and the bowtie or 'X' features were still observed. An additional migration using a velocity of 0.3 m/ns was used with the hope that if this feature was due to air wave interaction that the secondary migration would remove the 'X'.

Figure 6.17 shows the WOODNEW transect processed with both 0.1 m/ns and 0.3 m/ns velocities. With the use of the additional 2-D Migration, the shallow cross over feature appears to be removed; however, the deeper one is still present and the remaining data appear over-migrated and concave upward which is the result of the wrong velocity being used. In most cases the use of the air wave velocity to migrate the data was completed separately so that the data can be modeled in order to subtract out the full hyperbolic response of the non geologic reflector from the original data (Sun, 1994).

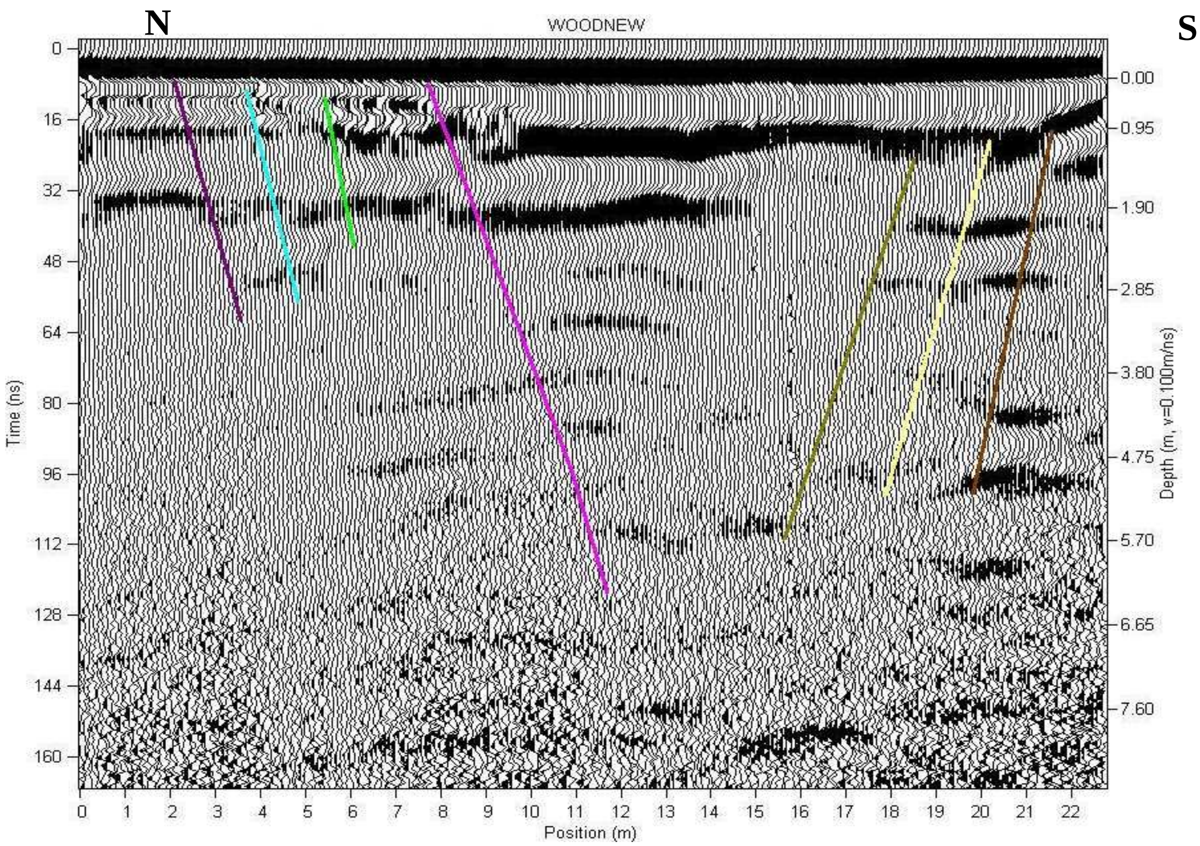


Figure 6.15. WOODNEW Raw Data. The purple, blue, green, purple pink, olive, cream and brown lines denote offsets of beds.

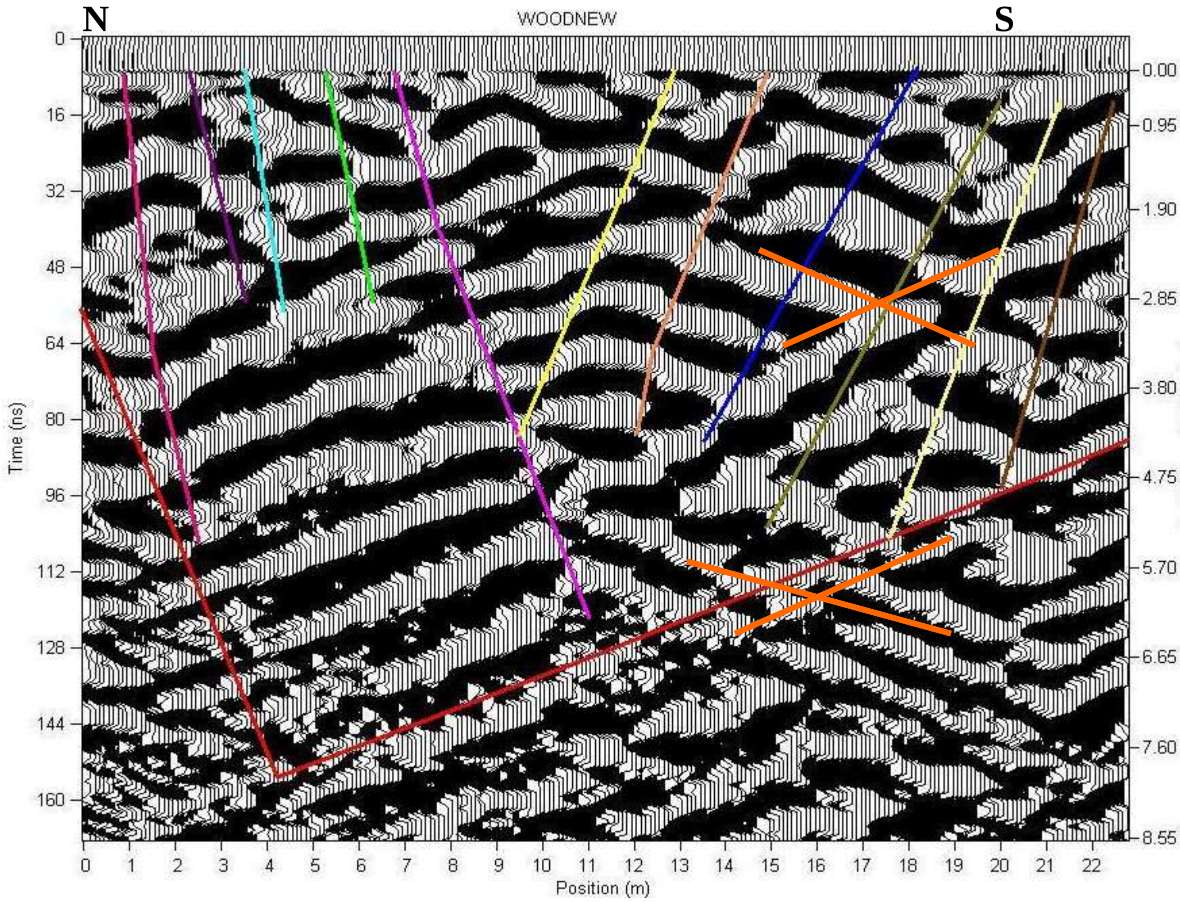


Figure 6.16. WOODNEW Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green, yellow, orange, royal blue, olive, cream and brown lines denote offsets of beds. The bright orange 'X's' outline crossovers observed in this transect.

However, in the case of my research, I did not perform any type of modeling in order to process my data. Instead the intent was to see how the initial 0.1 m/ns migration removed anomalies in the data, and then to apply an additional migration if an 'X' feature was observed using 0.3 m/ns. The air wave velocity migration was tested on the data by itself, and in conjunction with the 0.1 m/ns velocity migration. When applied alone, all data appeared to be over migrated and incoherent, when in conjunction with 0.1 m/ns , the data in some cases appeared to be over migrated, but did not appear to over power all reflectors.

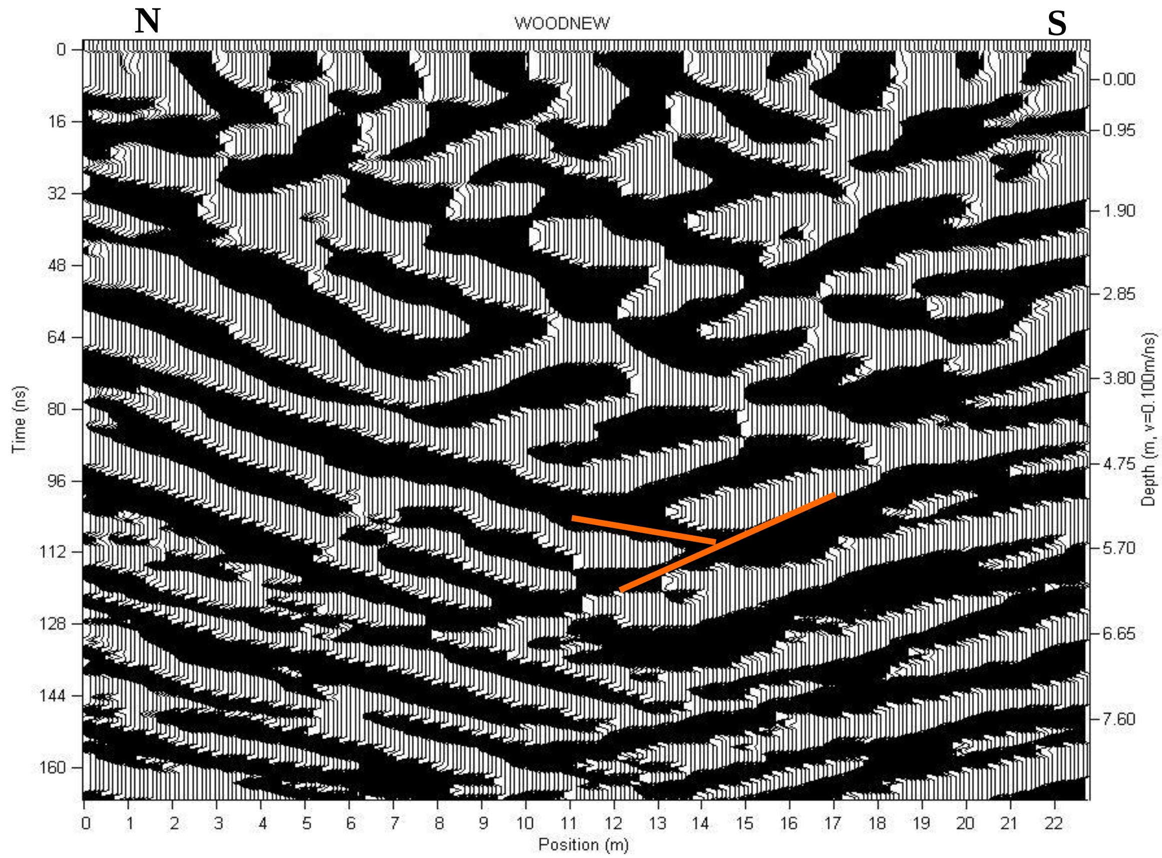


Figure 6.17. WOODNEW Processed Data with two migration velocities (0.1 m/ns, 0.3 m/ns). The bright orange 'X' outlines the deeper crossover as observed in Figure 6.16

6.2 Former Woodlawn High School, South of Band Room

The following sections deal with the yellow area which includes the following transects starting with those adjacent to the southern Band room wall: WOOD2_T3, WD2_T6F, WD2_T13F/WD2_T13R and WD_T23R. These sections only focus on transects WD2_T6F and WD2_T23F/WD2_T13R, the remaining transects are discussed in detail in Appendix J. All transects were processed as described in Chapter III, Data Processing Methodologies.

6.2.1 Transect WD2_T6F

Transect WD2_T6F is parallel to the southern Band Room Wall; at a 90^{o} angle to the red area transects, and between transects WD2_T3 and WD2_T13F/R (Figure 6.10). The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to an approximate TWTT of 171.6 ns, or a depth of 8.58 m, using a velocity of 0.1 m/ns, the depth would be between 5.15 m and 6 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure 6.18 is a Wiggle Trace view of the raw WD2_T6F transect data which shows very little reflected energy. Figure 6.19 is the transect WD2_T6F after processing and shows several reflected features.

Transect WD2_T6F contains two faint offsets in bedding observed at shallow depths from a minimum TWTT of 16 ns to a maximum of 64 ns, or a depth of 0.8 m to a maximum depth of 3.2 m. Each of these offsets are located at horizontal distances of 3.7 m and 12.2 m and are outlined in Figure 6.18 in yellow and purple respectively. The same crossover that is observed in transect WOOD2_T3, which is obscured in the raw data, is also observed in the processed data for transect WD2_T6F. This crossover spans the entire length of the transect, has a maximum TWTT of 112 ns, or a depth of 5.6 m, and is marked in Figure 6.19 in red. There are five more shallow offsets observed in the processed data that are located at horizontal distances of 6.7 m, 7.7 m, 9.7 m, 13.7 m and 15.7 m, and are outlined in Figure 6.19 in purple pink, blue, green, orange and cream respectively. However, there is a cross over feature that appears at a horizontal distance of 7.7 m and a maximum depth of 5.6 m that appears to be an artifact that is not a result of soil geology. As before, I attempted to remove the crossover by migrating the data using the air wave velocity, 0.3 m/ns. Figure 6.20 shows the WD2_T6F transect processed with both 0.1 m/ns and 0.3 m/ns velocities. With the use of the additional 2-D Migration, the cross over feature is still present and the bulk of the data is over migrated and concave upwards, due to an incorrect velocity.

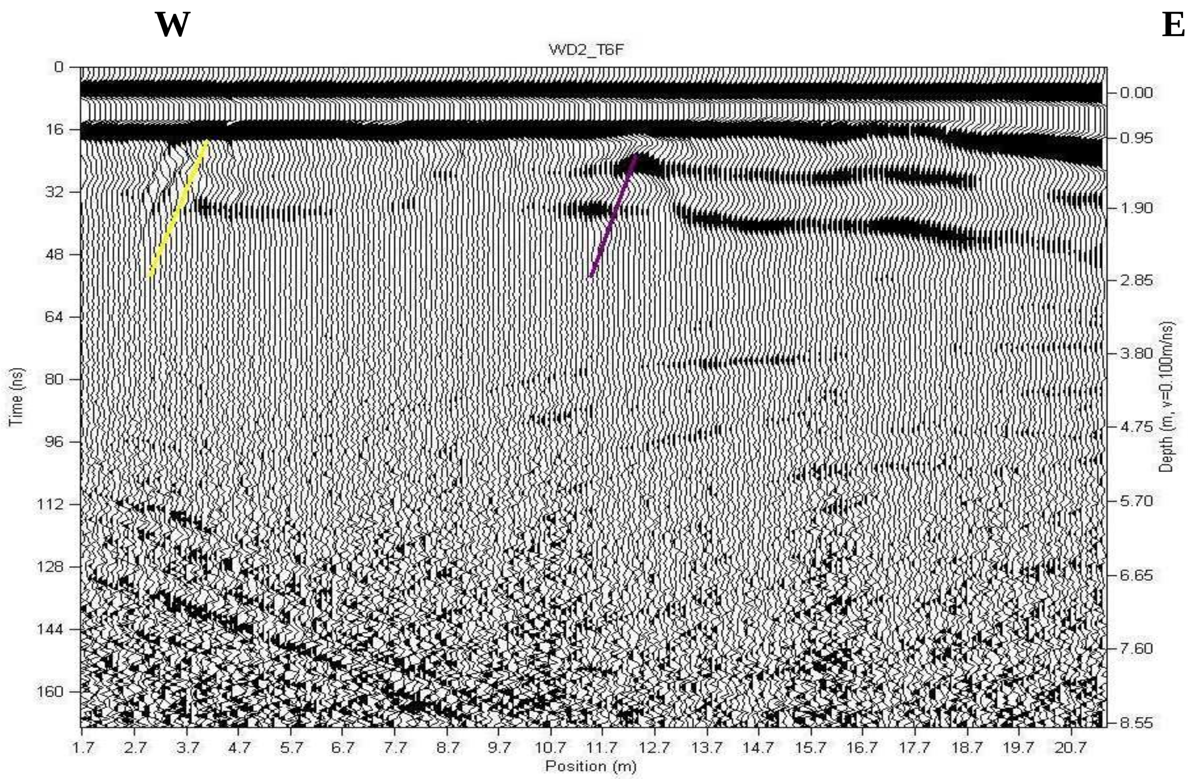


Figure 6.18. WD2_T6F Raw Data. The yellow and purple pink lines denote offsets of beds.

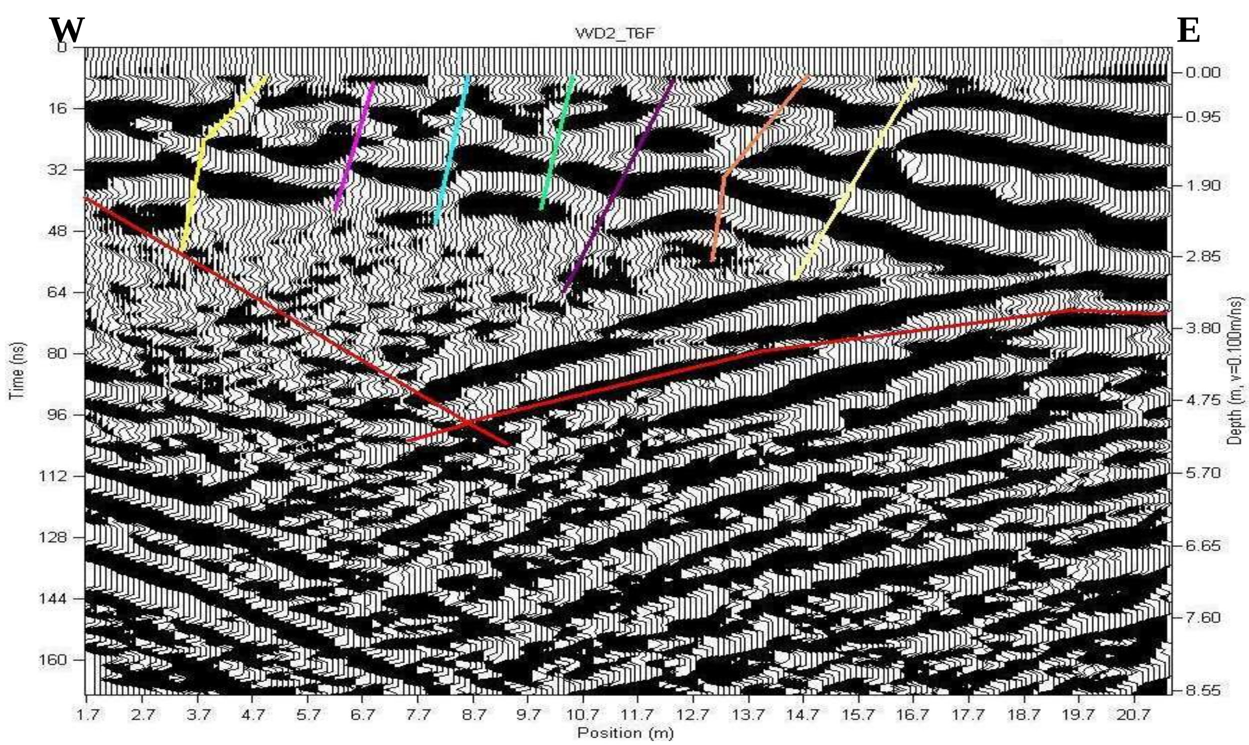


Figure 6.19. WD2_T6F Processed Data. The red line is a portion of the crossover observed throughout the transects, the yellow, purple pink, blue, green, purple, orange and cream lines denote offsets of beds.

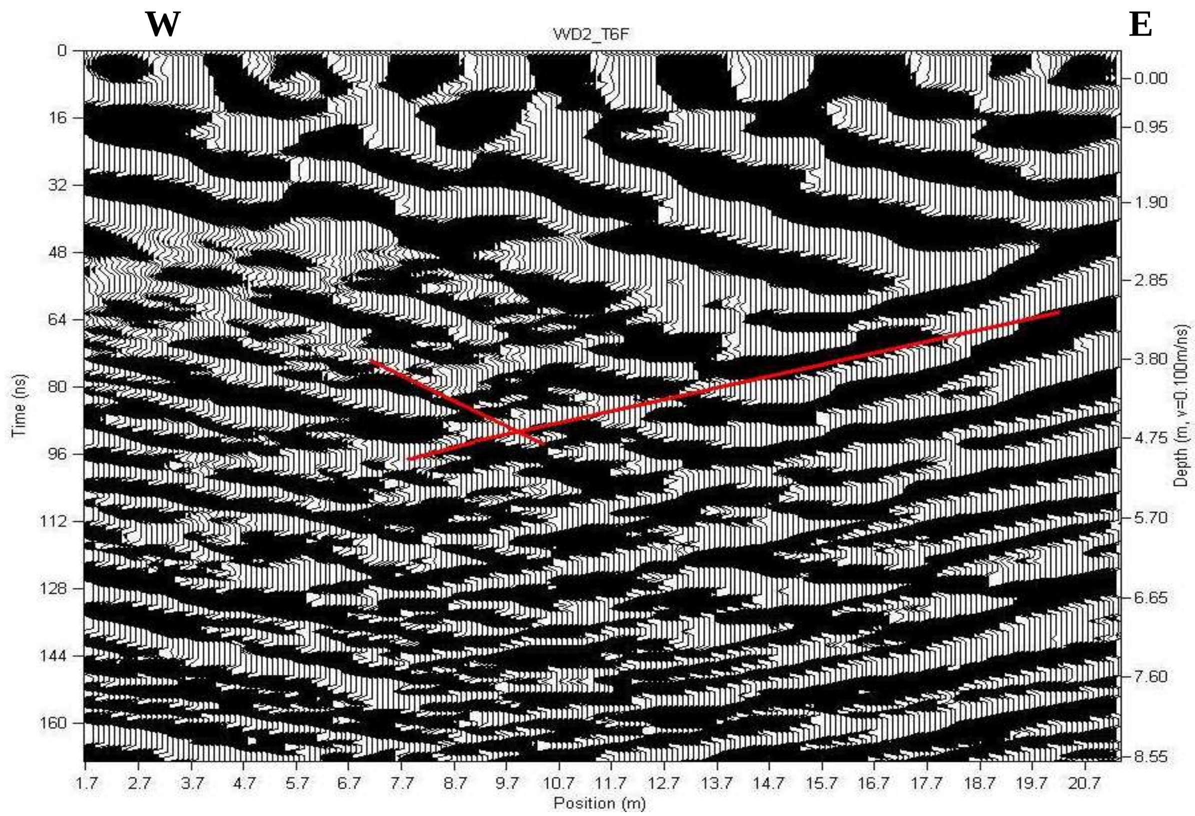


Figure 6.20. WD2_T6F Processed Data with two migration velocities (0.1 m/ns, 0.3 m/ns). The red line again is a portion of the crossover observed throughout the processing of this transect.

6.2.2 Transects WD2_T13F and WD2_T13R

Transects WD2_T13F and WD2_T13R are parallel to the southern Band Room Wall, at a 90^o angle to the red area transects, and between transects WD2_T6F and WD_T23R (Figure 6.10). Transects WD2_T13F and WD2_T13R are the same transects. WD2_T13F is the forward transect that covers a total distance of 19 m. WD2_T13R is the reverse of the previous transect, starting at the end of WD2_T13F and working towards the beginning, but it only covers a total distance of 6.9 m. Prior to actual processing and comparison of the WD2_T13R transect to the WD2_T13F transect, the transect data needed to be reversed so that the orientation of the traces was in the same direction. When comparing these two transects, WD2_T13R mirrors the response observed in WD2_T13F for the last 6.9 m of section which begins at a horizontal distance of 12.1 m and continues to the end of section at 19 m.

The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to an approximate TWTT of 180.4 ns, or a depth of 9.02 m, using a velocity of 0.1 m/ns, the depth would be between 5.41 m and 6.31 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figures 6.21 and 6.22 are Wiggle Trace views of both the raw WD2_T13F and reverse transect WD2_T13R data which shows very little reflected energy. Figures 6.23 and 6.24 are the processed transects WD2_T13F and WD2_T13R, which shows several reflected features and a crossover.

When reviewing the raw data for transect WD2_T13F there are two faint offsets in bedding observed at shallow depths from a minimum TWTT of 16 ns to a maximum TWTT of 64 ns, or a minimum depth of 0.8 m to a maximum depth of 3.2 m, and a portion of the crossover at a maximum depth of 3.2 m. Each of these offsets are located at horizontal distances of 9.7 m and 11.2 m and are outlined in Figure 6.21 in green and purple respectively. When reviewing the raw data for transect WD2_T13R the only reflector observed is a portion of the crossover at a maximum TWTT of 128 ns, or a depth of 6.4 m, and is outlined in Figure 6.22 in red. The crossover seen in the raw data and processed data, spans the entire length of each transect, at a maximum TWTT of 114.4 ns, or depth of approximately 5.72 m, and is marked in Figures 6.23 and 6.24 in red. There are five more shallow offsets observed in the processed data for WD2_T13F. Three of these offsets are north and two south of the offsets observed in the raw data. These additional shallow offsets are located at horizontal distances of 4.7 m, 6.7 m, 8.2 m, 13.2 m and 15.7 m, and are outlined in Figure 6.23 in yellow, purple pink, blue, orange and cream respectively. There are two shallow offsets observed in the processed data for WD2_T13R that are not seen in the raw data. These shallow offsets are located at horizontal distances of 6.6 m and 4.6 m in relation to the WD2_T13R transect and at distances of 15.6 m and 17.6 m in relation to the WD2_T13F transect, and at a minimum depth of 0.8 m and a TWTT of 96 ns or a maximum depth of 4.8 m.

There is a cross over feature that appears at a horizontal distance of 18.7 m and a maximum depth of 5.72 m that appears to be an artifact that is not a result of soil geology. I tried to remove the crossover by migrating the data using the air wave velocity, 0.3 m/ns. Figures 6.25 and 6.26 show transects WD2_T13F and WD2_T13R processed with both 0.1 m/ns and 0.3 m/ns velocities. With the use of the additional 2-D Migration, the cross over feature is no longer present; however the bulk of the data is over migrated and concave upwards, due to the use of an incorrect velocity (0.3 m/ns).

6.3 Former Woodlawn High School, inside Band Room going east

The following sections deal with the blue area which includes the following transects starting with those furthest west and working east: BAND1 and BAND2 (Figure 6.10). All transects were processed as described in Chapter III, Data Processing Methodologies.

6.3.1 Transects BAND1 and BAND2

Transects BAND1 and BAND2 are located inside the Band Room, on the west and east walls respectively (Figure 6.10). Transect BAND1 was collected for a total horizontal distance of 8.2 m and Transect BAND2 was collected for a total horizontal distance of 7.2 m. The reflections shown in the Ekko_View imaging program for these transects were received from ground surface to the total TWTT of approximately 467.8 ns, or depth of signal penetration which was approximately 23.39 m, using a velocity of 0.1 m/ns, the depth would be between 14.03 m and 16.37 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figures 6.27a and 6.27b are Wiggle Trace views of the raw data for BAND1 and BAND2 transects respectively, which shows relatively horizontal reflectors at shallow depths from ground surface to the total depth of

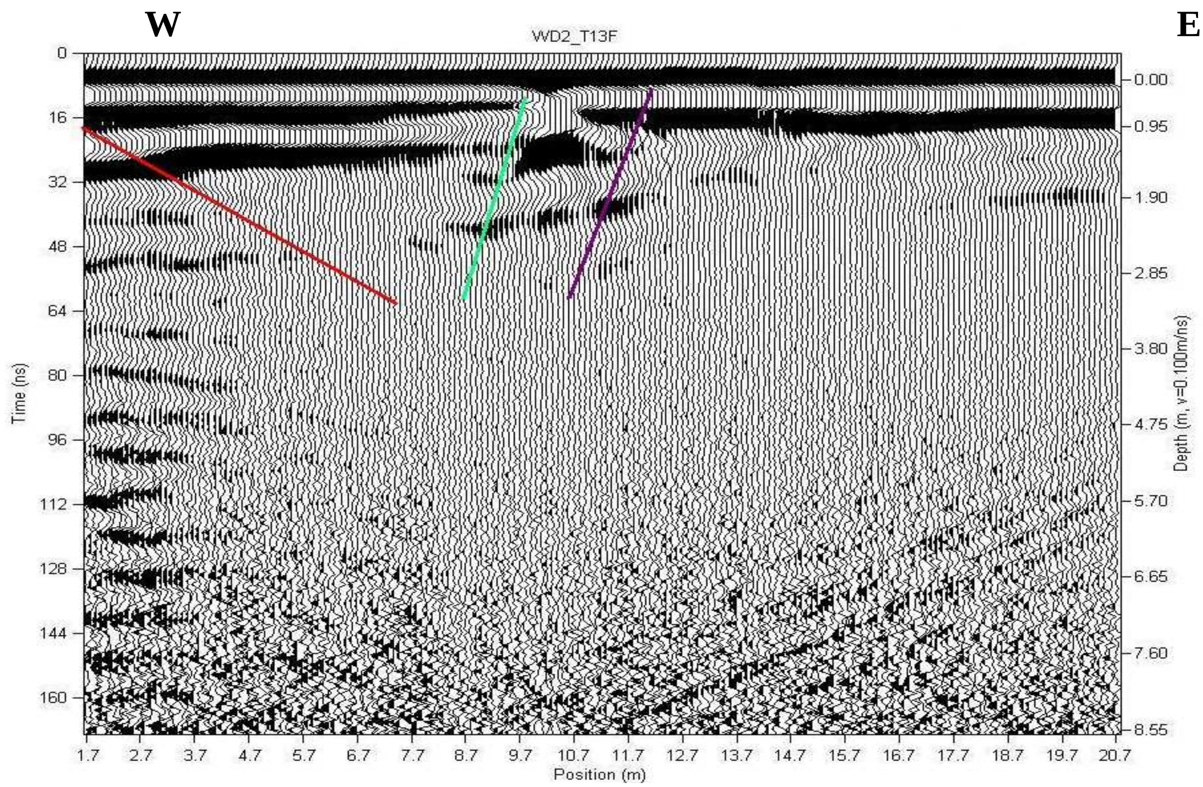


Figure 6.21 WD2_T13F Raw Data. The red line is a portion of the crossover observed throughout the transects, the green and purple lines denote offsets of beds.

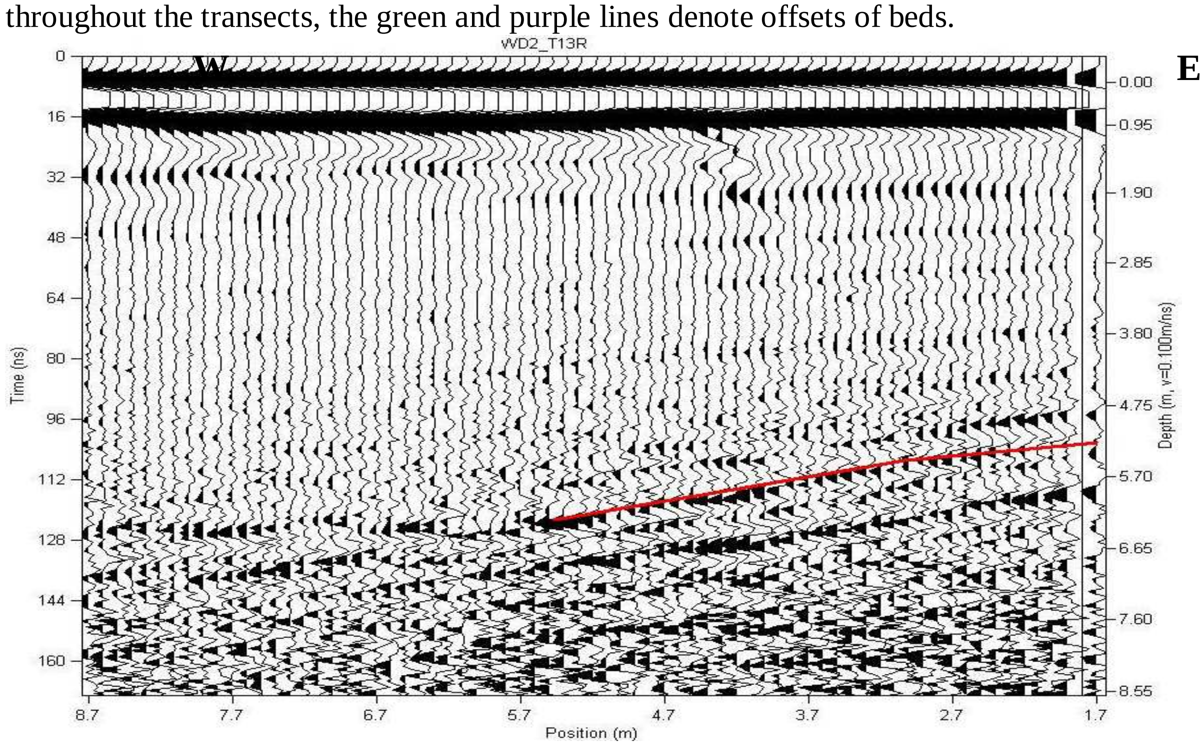


Figure 6.22 WD2_T13R Raw Data. The red line is a portion of the crossover observed throughout the transects.

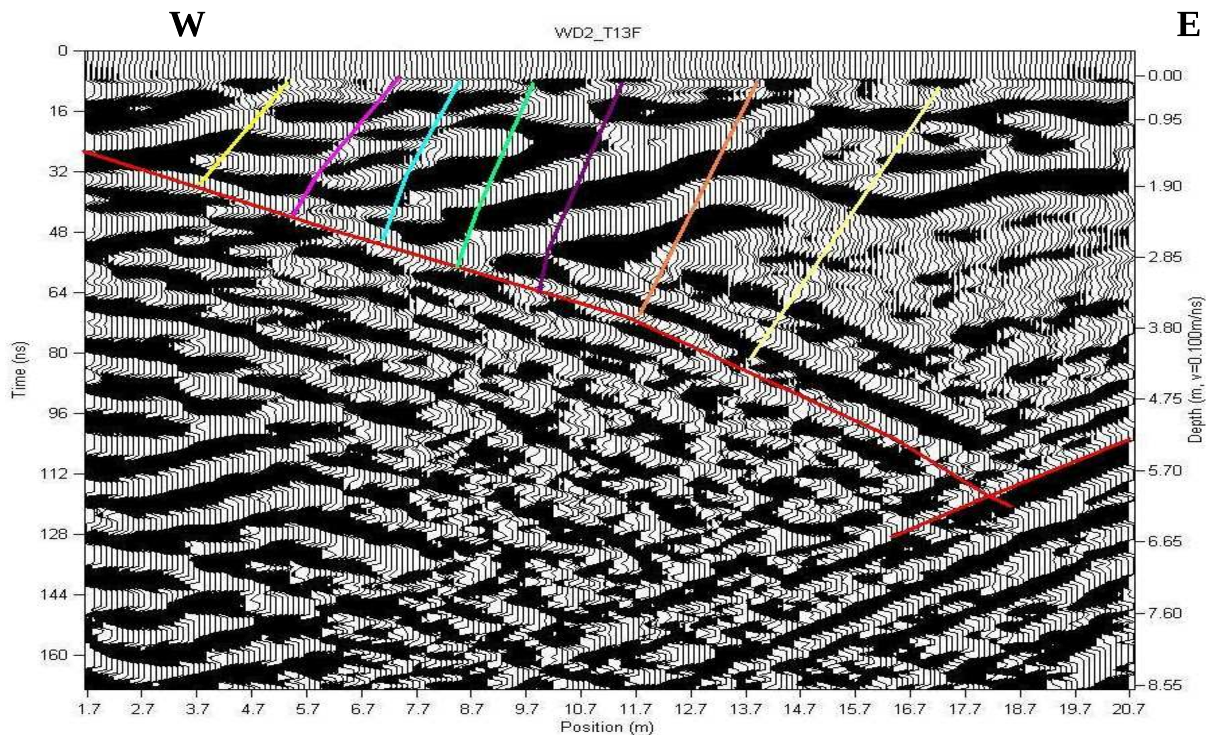


Figure 6.23 WD2_T13F Processed Data. The red line is a portion of the crossover observed throughout the transects, the yellow, purple pink, blue, green, purple, orange and cream lines denote offsets of beds.

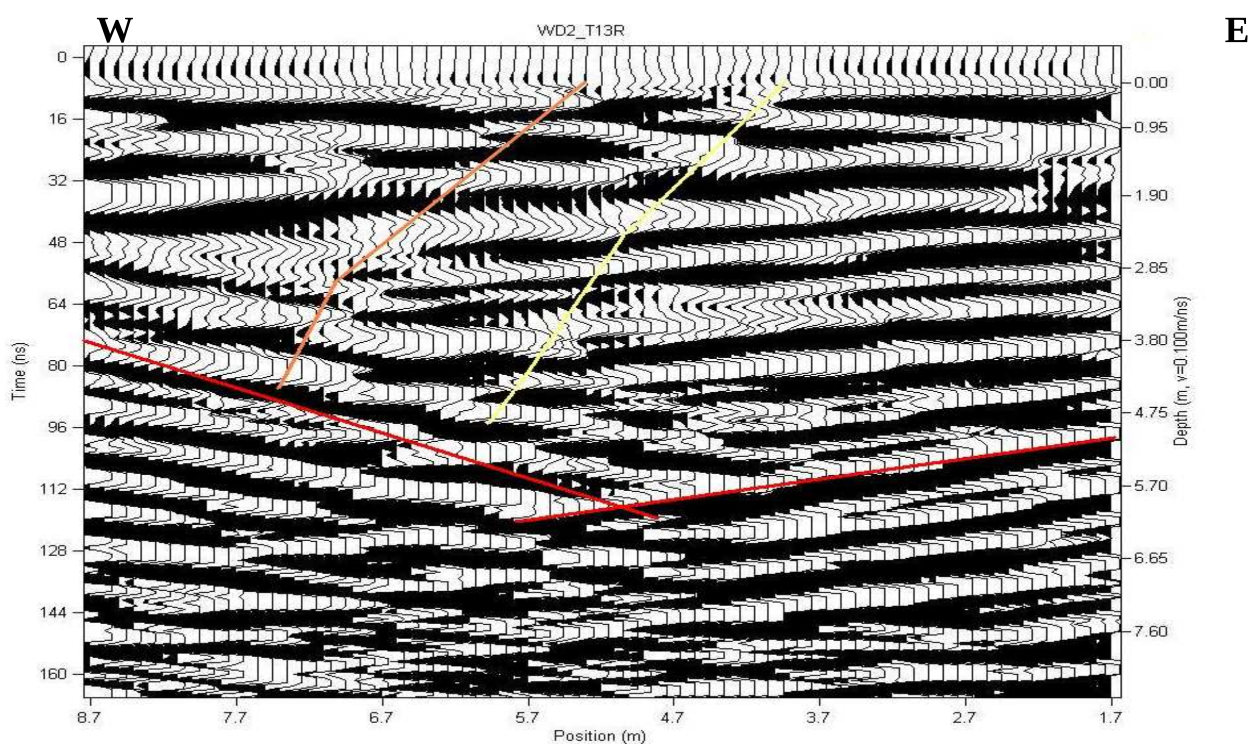


Figure 6.24 WD2_T13R Processed Data. The red line is a portion of the crossover observed throughout the transects, the orange and cream lines denote offsets of beds.

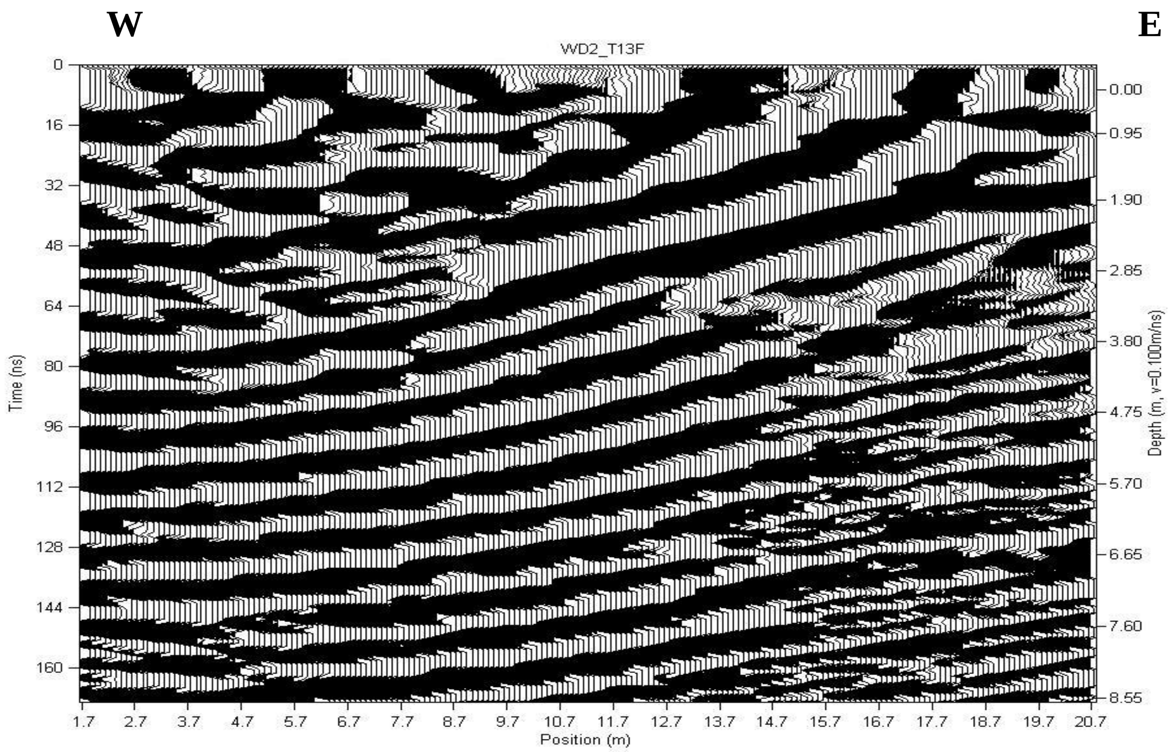


Figure 6.25. WD2_T13F Processed Data with two migration velocities (0.1 m/ns, 0.3 m/ns). Crossover observed in previous processed views, is no longer present.

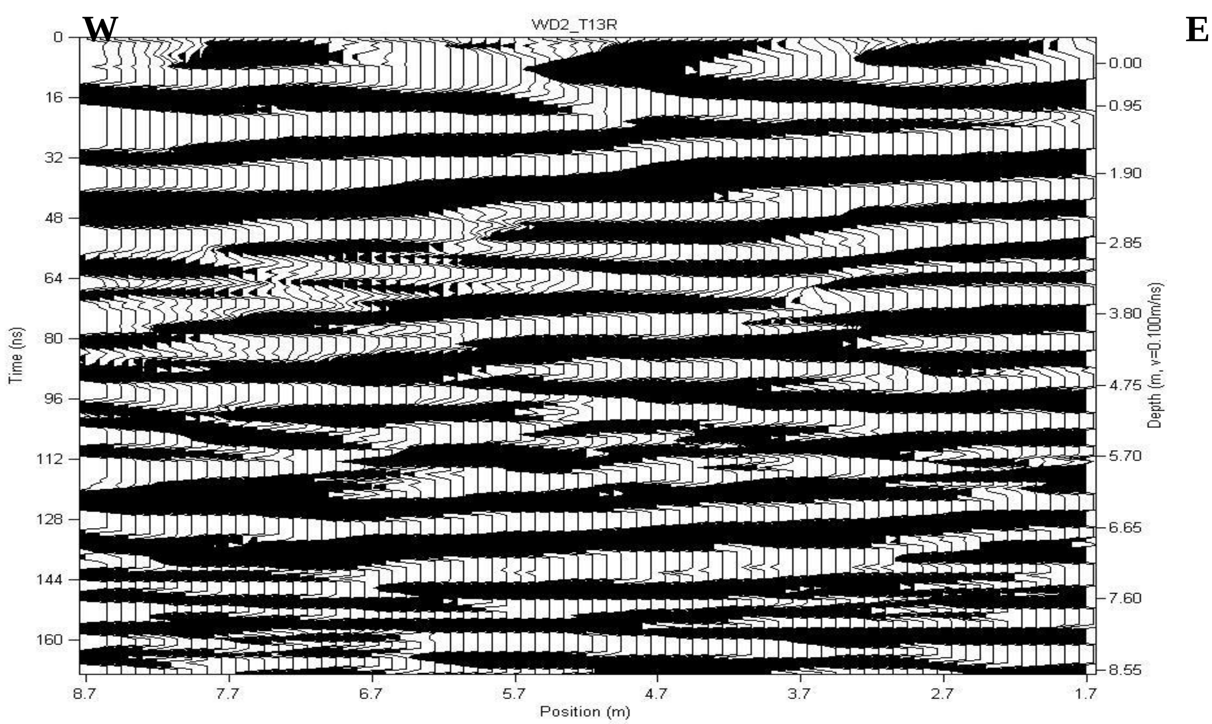


Figure 6.26. WD2_T13R Processed Data with two migration velocities (0.1 m/ns, 0.3 m/ns). Crossover observed in previous processed views, is no longer present.

signal penetration, and three offsets in BAND1 and two offsets in BAND2. Of the three offsets in BAND1 two are dipping towards the south and one towards the north. Of the two offsets in BAND 2 both are dipping towards the south. Figures 6.28a and 6.28b are the same transects BAND1 and BAND2, but they are in processed Wiggle Trace views which shows a bowl shaped feature and additional offsets.

Transects BAND1 and BAND2 contain two offsets in bedding that dip towards the south at shallow depths, from ground surface to a TWTT of 64 ns, or an approximate depth of 3.2 m bgs, and at horizontal distances of 0.5 m and 2 m, respectively. These two offsets are outlined in Figures 6.27 a and b and 6.28 a and b in light pink and purple. In the raw BAND1 transect a third offset is observed towards the end of the section that dips towards the north, at a horizontal distance of 7 m. This offset is outlined in Figures 6.27a, and 6.28 a and b in yellow.

In both transects a bowl shaped feature is observed spanning the entire length of the transects, starting at an approximate TWTT of 48 ns, or a depth of 2.4 m and a maximum TWTT of 80 ns, or a depth of 4.0 m , and are marked in Figures 6.28 a and b in red. There are three more shallow offsets in BAND1 and four more shallow offsets in BAND2 in the processed sections. Overall when comparing BAND1 to BAND2 each offset matches up with the corresponding colored offset in the other transect. The additional shallow offsets are located at horizontal distances of 3 m, 4 m and 5.5 m, and are outlined in Figures 6.28 a and b in blue, green and purple pink respectively.

6.4 Former Woodlawn High School, outside Walkways between Buildings going East

The following sections deal with the green area which includes the following transects starting with those furthest west and working east: WAYWALK1 and WAYWALK2 (Figure 6.10). This section only focuses on transect WAYWALK1, the remaining transect is discussed

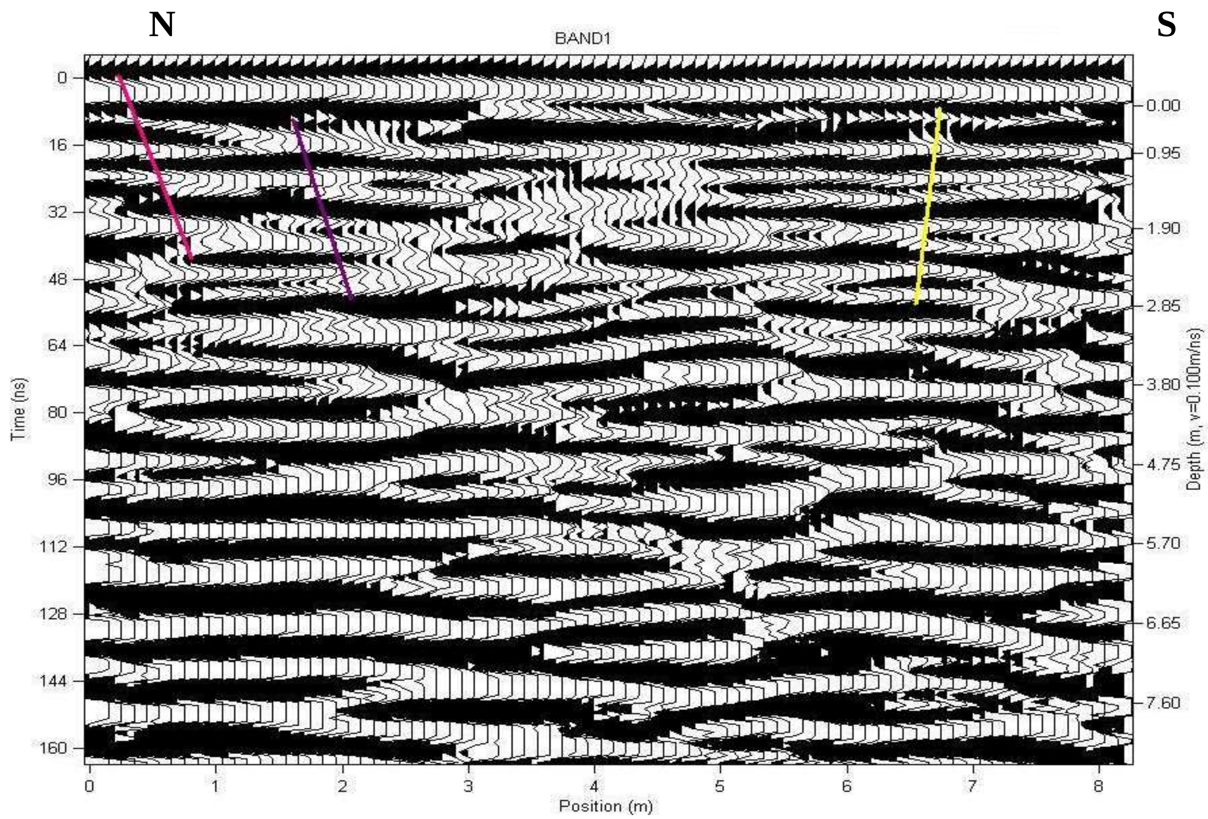


Figure 6.27a. BAND1 Raw Data. The light pink, purple and yellow lines denote offsets of beds.

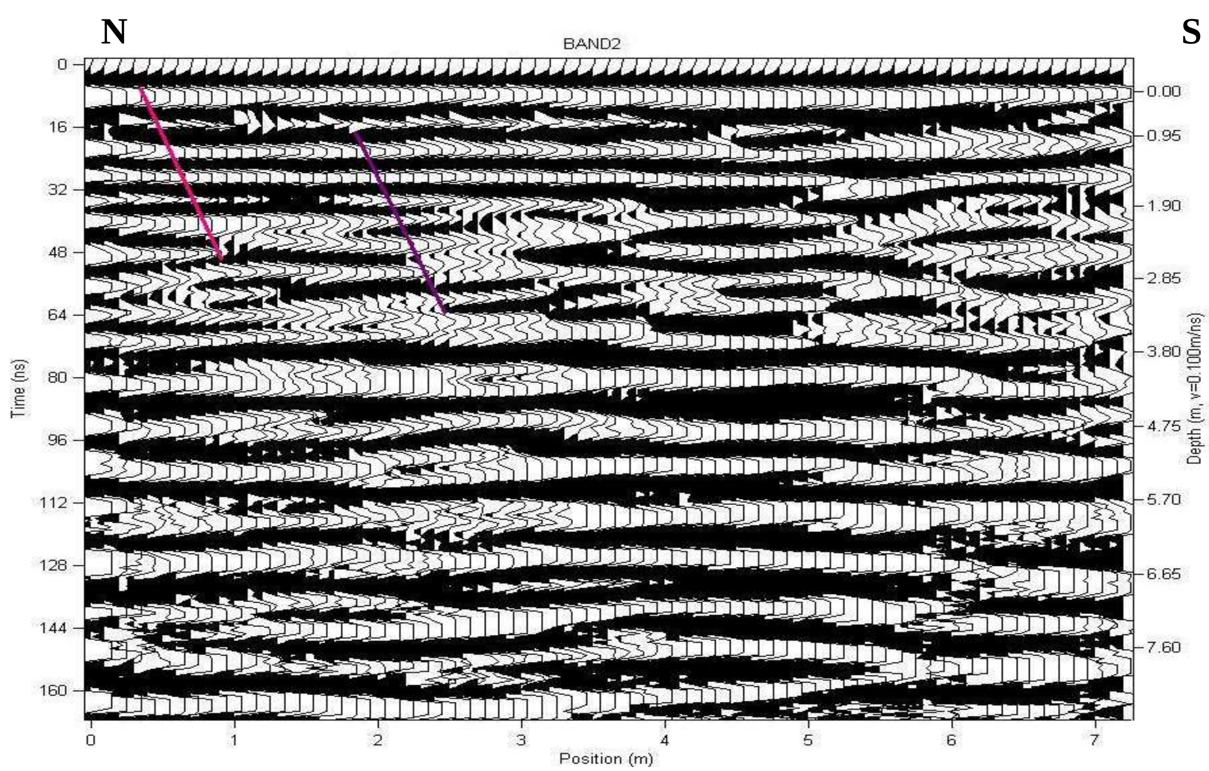


Figure 6.27b. BAND2 Raw Data. The light pink and purple lines denote offsets of beds.

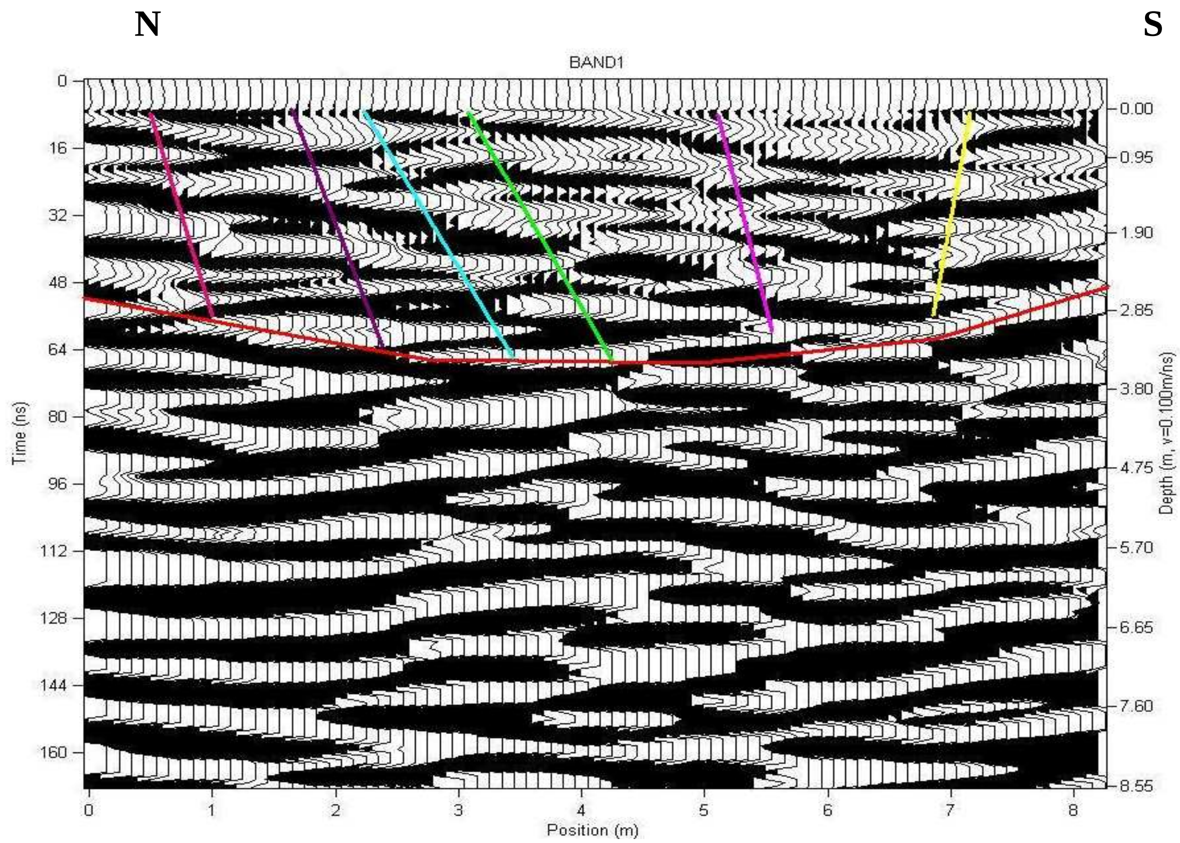


Figure 6.28a. BAND1 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green and yellow lines denote offsets of beds.

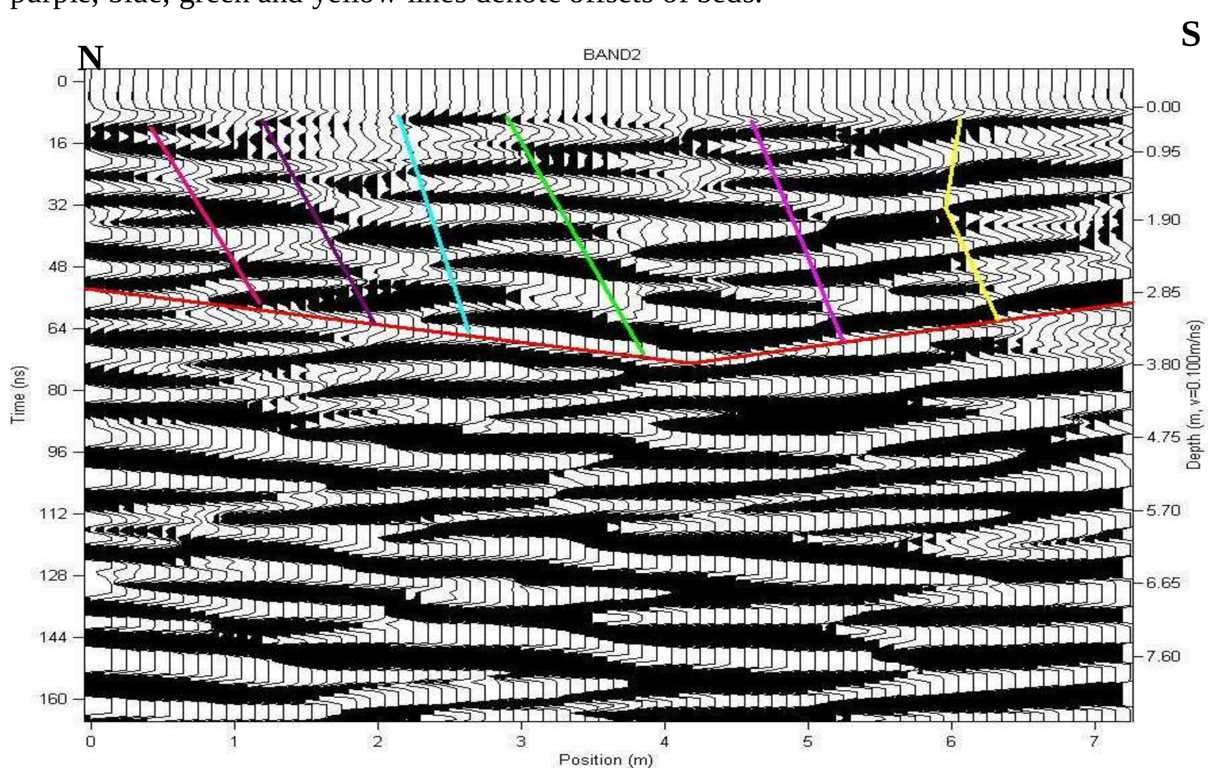


Figure 6.28b. BAND2 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green and yellow lines denote offsets of beds.

in detail in Appendix J. All transects were processed as described in Chapter III, Data Processing Methodologies.

6.4.1 Transect WAYWALK1

Transect WAYWALK1 is located in an open roofed walkway area between the Band Room and Auditorium (Figure 6.10). The reflections observed were received from ground surface to a TWTT of approximately 266 ns, or a depth of 13.3 m, using a velocity of 0.1 m/ns, the depth would be between 7.98 m and 9.31 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure 6.29 is a Wiggle Trace view of the raw WAYWALK1 transect data which shows relatively horizontal reflectors from ground surface to approximately 13.3 m, and two bedding offsets dipping towards the south. Figure 6.30 is the same transect WAYWALK1, but is a processed Wiggle Trace view which shows a bowl shaped feature and four additional offsets dipping southward.

Transect WAYWALK1 contains two faint offsets in bedding observed at shallow depths, from ground surface to a TWTT of approximately 80 ns, or a depth of 4.0 m bgs, and at horizontal distances of 1.5 m and 5.5 m respectively. These two offsets are outlined in Figures 6.29 and 6.30 in light pink and green. The same bowl shaped feature observed previously in the red and blue areas are also observed in the WAYWALK1 processed section and span the entire length of the transect, starting at an approximate TWTT of 64 ns, or a depth of 3.2 m, to a maximum TWTT of 80 ns, or a depth of 4.0 m, and is marked in Figure 6.23 in red. There are four more shallow offsets observed in the processed data and are located between the offsets observed in the raw data. These additional shallow offsets are located at horizontal distances of 2.5 m, 3 m, 6 m and 7.5 m, and are outlined in Figure 6.30 in purple, blue, purple pink and yellow respectively.

6.5 GPR Data Results for Glen Oaks High School

A total of 5 transects of GPR data were collected at Glen Oaks High School. These transects were concentrated on the eastern and western sides of the former Building H. The interior covered walkway is to the east of the former Building H (demolished in the late 1980's), the exterior covered walkway and exterior driveway are both to the west of the former Building H. Figure 6.31 is a topographic map showing the location and building orientations of this field study area. These transects were concentrated in this area of the property because of the historic structural damage as well as the current visual structural damage observed at ground surface in the onsite covered walkways and driveways. Figures 6.32 through 6.39 are photographs of the property tracing the structural damage from the eastern side of the inside covered walkway to the western roadway.

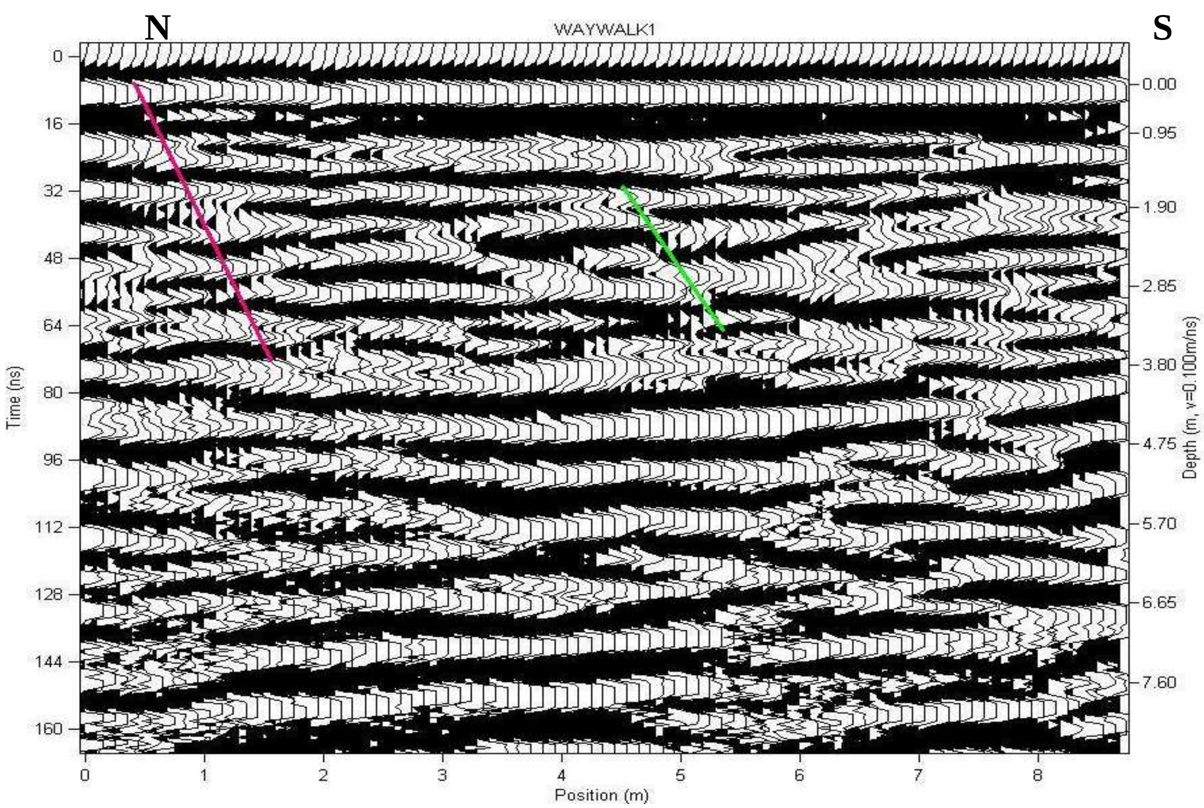


Figure 6.29. WAYWALK1 Raw Data. The light pink and green lines denote offsets of beds.

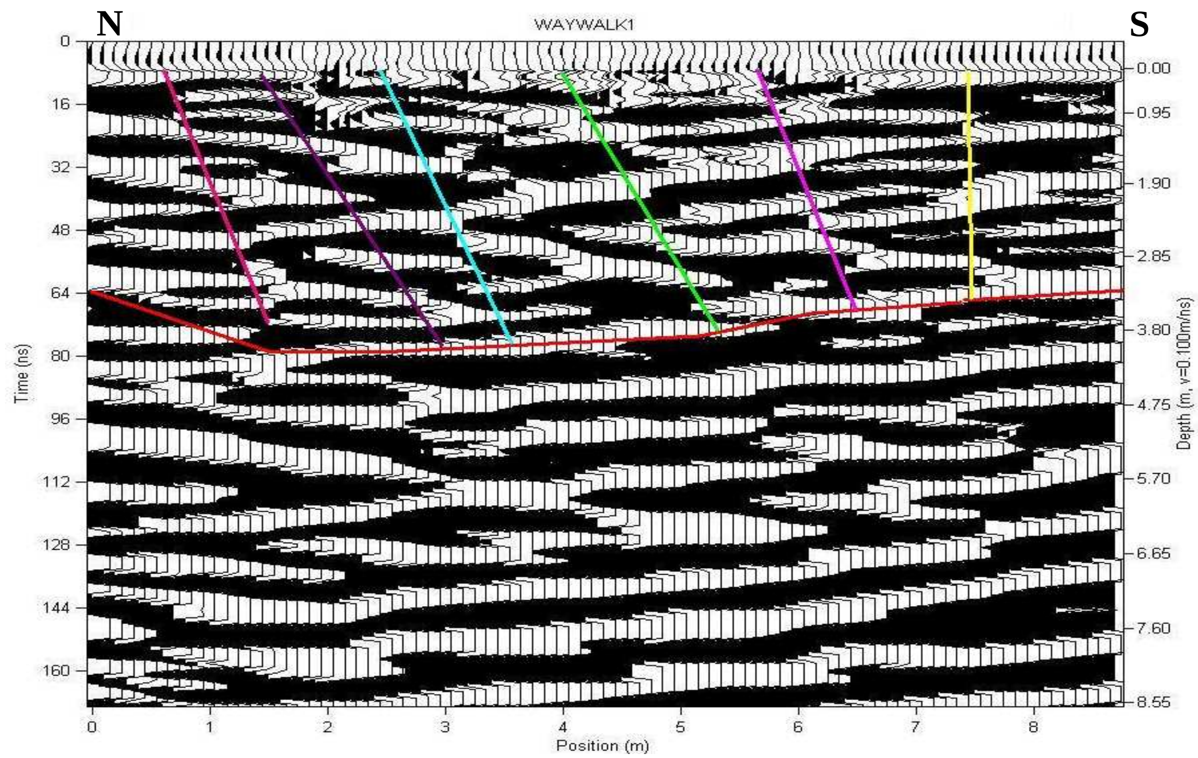


Figure 6.30. WAYWALK1 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green and yellow denote offsets of beds.

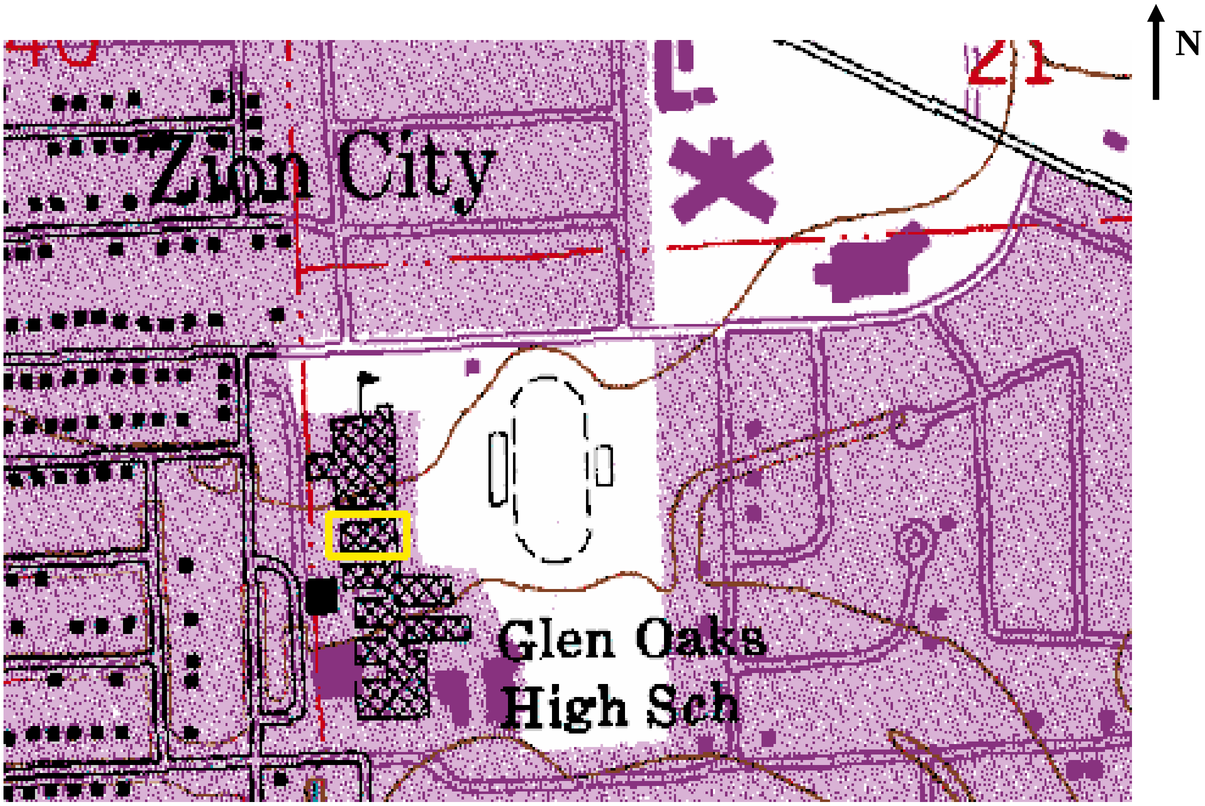
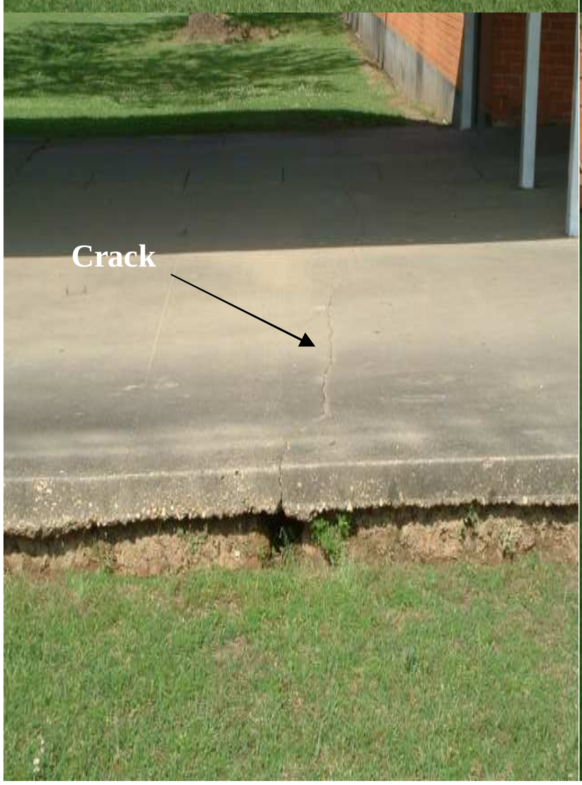


Figure 6.31, zoomed in version of the topographic map. The area in yellow is the former Building H. Scale is 1" measured equals 723.4 ft on the ground.

West East West East


Figure 6.32


Figure 6.34



Figures 6.32 and 6.33 are of the eastern side and Figures 6.34 and 6.35 are the western side of the inside covered walkway, where WLKWY1-3 were collected.

West East West East

Figure 6.36 is of the outside covered walkway where OSWLKWY1 was collected. Figure 6.37 is of the eastern curb, Figure 6.38 is the actual driveway and Figure 6.39 is the western curb of the driveway, DVWY1.

According to historical observations and reports in this area of East Baton Rouge Parish, surface structural damage is a result of movement along the Scotlandville Fault. For this field study area, the GPR transects completed are divided into two areas: WLKWY1 through 3 which is the red area are located on the eastern side of the former Building H within the interior covered walkway; and OSWLKWY1 and DVWY1 which are in the blue area located on the western side of the former Building H. All transects are perpendicular to the trend of the Scotlandville fault.

For each GPR transect, interpretations were made both in the raw and processed data. Each geologic feature, such as a fault or offset has been color coded to be correlated both between the raw vs. the processed versions of the transect itself as well as comparing between different transects. The color coding allows for correlation spatially within the individual transect and between transects.

The following sections describe in detail what observations can be drawn from the raw data versus the processed data. All interpretations were made in consultation with Ann Heim, 30 yr geophysicist veteran of Shell Oil Company. During this consultation, Ms. Heim commented that these transects, especially those through the inside Walkway (WLKWY1-3) are very noisy. Care was taken to test whether or not to include the AGC gain or remove all gain completely. No gain was used for transects OSWLKWY1, WLKWY1 and WLKWY3 because the gain used amplified the noise in the data which made it harder to interpret. Heim has also suggested that additional faults may be in the transects going north; however, those already picked may be migration swing interference and thus the others may be interference as well. At least those selected can be correlated throughout all of the transects (Heim, personal communication). Each of the Glen Oaks transects were processed using the following recipe: DEWOW; Background Subtraction using 41 traces to average; Automatic Gain Control (AGC) with a default window width of 0.1 and a gain maximum of 10 only for transects WLKWY2 and DVWY1; BandPass filter using the corner frequencies of 0, 40, 300 and 340, except for DVWY1 which used corner frequencies of 0, 50, 300 and 350; and 2-D Migration using a velocity of 0.1 m/ns, spatial offset of 0.0, and a scale of 0.2, except for DVWY1. No migration was used for processing transect DVWY1 due to the data being over migrated regardless of the velocity used. Figure 6.40 is a map showing the orientation of each transect versus the former Building H.

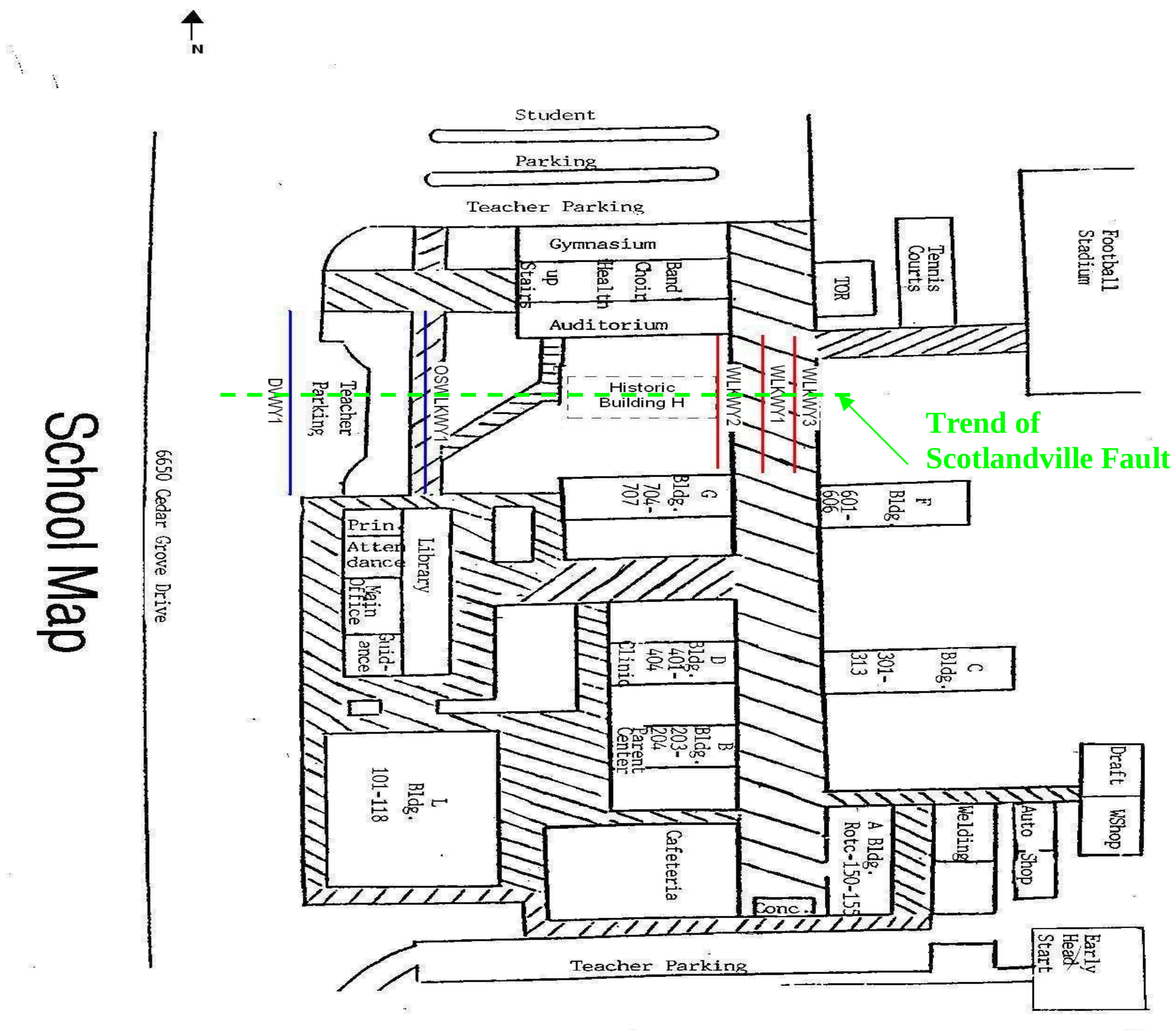


Figure 6.40. Site Map of Glen Oaks High School Field Study Area. Transects in red are to the east and those in blue are to the west of former Building H.

The following sections describe in detail what observations can be made from viewing the raw data versus the processed data. In looking at the following transects in Wiggle Trace form, on the left axis Two Way Travel Time (TWTT) in nanoseconds (ns) is labeled and on the right axis Depth in meters (m) is labeled. The Depth has been calculated by the Sensoft data acquisition program, PulseEkko 100 based upon a velocity of 0.1 m/ns. Appendix I shows approximate depth of reflectors based upon using different velocities. Once the data has been processed both features observed in the raw data as well as additional ones are revealed. Comparisons between each of these transects were made to determine where the true geologic reflector data ended in order to crop the data. The result was to crop all transects to a TWTT of approximately 180 ns, which in some of the transects still shows some deeper noise or multiples in the data; however, overall tends to concentrate on just the real geologic reflector data observed. When reviewing the transect data below an approximate maximum TWTT of 180 ns, in many cases TWTT is smaller, the data appears to be overwhelmed with noise and there is little to no coherence in the data. However, there are some angled reflectors that appear to be an artifact, such as multiples, that are not a result of soil geology. The following sections deal with the red area which includes the following transects starting with those furthest east of the former Building H working westward: WLKWY3, WLKWY1 and WLKWY2 (Figure 6.40). This section only focuses on transect WLKWY3, the remaining transects are discussed in detail in Appendix K.

6.5.1 Transect Walkway 3#(WLKWY3)East of Building H

Transect WLKWY3 is located on the furthest eastern side of the interior covered walkway, and to the east of WLKWY1 and WLKWY2 and the furthest east from the former Building H (Figure 6.40). The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to a TWTT of 178.8 ns, or a depth of 8.94 m, using a velocity of 0.1 m/ns, the depth would be between 5.36 m and 6.26 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure 6.41 is a Wiggle Trace view of the raw WLKWY3 transect data which shows the shallow reflectors to be relatively horizontal and one shallow offset in bedding dipping towards the north. Figure 6.42 is the same transect WLKWY3, but is a processed Wiggle Trace view which shows five shallow reflectors, four dipping towards the south and one dipping towards the north.

There is one faint offset in bedding observed in the raw data at shallow depths from a TWTT of 16 to 112 ns, or a minimum depth of 0.8 m to a maximum depth of 5.6 m that dips towards the north, and at a horizontal distance of 7.5 m in Figure 6.41 in green. The additional offsets observed in the processed data are more to the north and dip to the south. These additional shallow offsets are at a maximum TWTT of 143 ns, or a depth of 7.15 m, and are located at horizontal distances of 2 m, 3.5 m, 5 m and 6 m, and are outlined in Figure 6.42 in yellow, purple, pink and blue respectively.

6.6 Glen Oaks High School, West of former Building H

The following sections deal with the blue area which includes the following transects starting adjacent to the west side of the former Building H: OSWLKWY1 and DVWY1 (Figure 6.40). Each of these transects were processed as discussed previously in section 6.5. This section only focuses on transect DVWY1, the remaining transect is discussed in detail in Appendix K.

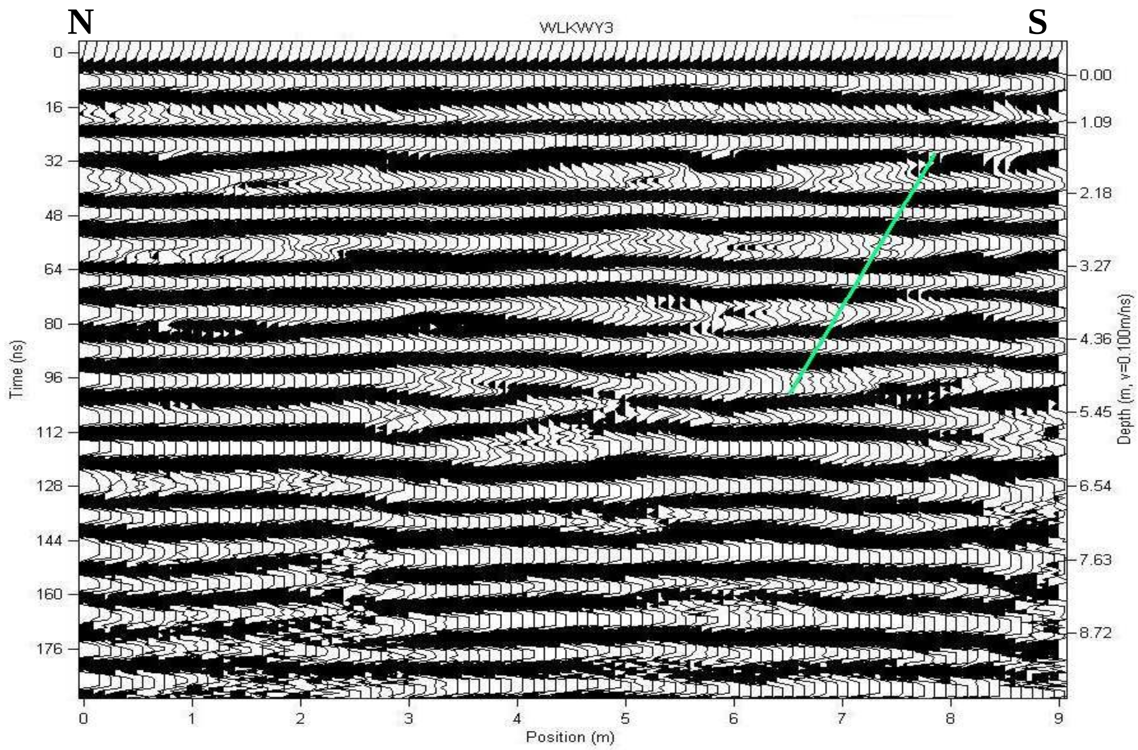


Figure 6.41. WLKWY3 Raw Data. The green line denotes an offset in bedding.

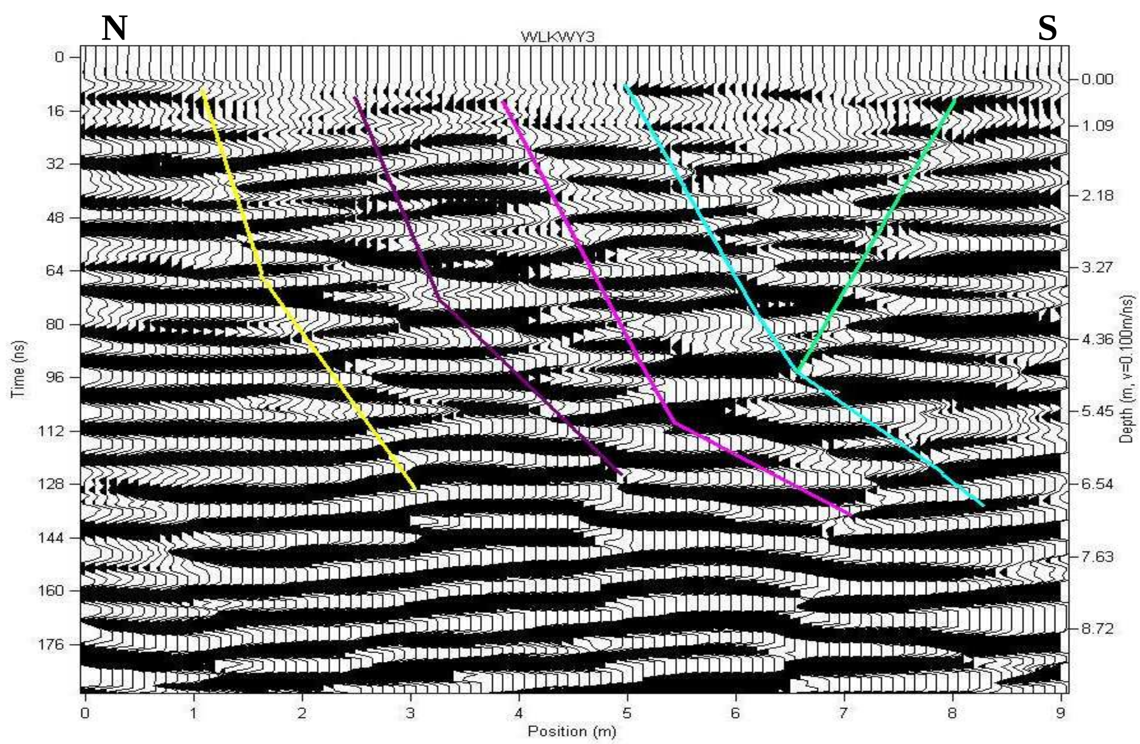


Figure 6.42. WLKWY3 Processed Data. The yellow, purple, pink, blue and green lines denote offsets of beds.

6.6.1 Transect Driveway1 (DVWY1), West of former Building H

Transect DVWY is the outside driveway, the furthest west transect away from the western side of the former Building H (Figure 6.40). The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to a TWTT of 201.2 ns, or a depth of 10.06 m, using a velocity of 0.1 m/ns, the depth would be between 6.04 m and 7.04 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure 6.43 is a Wiggle Trace view of the raw DVWY1 transect data which shows slightly dipping reflectors and one faint offset in bedding dipping south. Figure 6.44 is the same transect DVWY1, but is a processed Wiggle Trace view which shows four offsets in bedding.

There is one faint offset in bedding observed in the raw data at shallow depths from a minimum TWTT of 16 ns to a maximum of 28.6 ns, or a depth of 0.8 m to a maximum depth of 1.43 m, and at a horizontal distance of 27 m in blue (Figure 6.43). There are three additional offsets observed in the processed data. They are to the north and dipping southward (Figure 6.44). These additional offsets are located at horizontal distances of 18.5 m, 21 m and 24.5 m in yellow, purple and pink respectively in Figure 6.44, and the maximum depth of penetration for all bedding offsets in the processed data is 114.4 ns, or 5.72 m. There are two main crossover areas, whose center horizontal distances are 5 m and 24.5 m respectively and are outlined in Figures 6.44 and 6.45 in bright orange. I tried to eliminate the crossovers by migrating the data using the air wave velocity, 0.3 m/ns. Figure 6.45 shows the DVWY1 transect processed using only the 0.3 m/ns velocity for migration. With the use of this 2-D Migration, the cross over features are still present and the bulk of the data appears to be over migrated due to an incorrect velocity used. Initially the data was migrated using a velocity of 0.1 m/ns for concrete/asphalt; however, the same results were obtained as in the air wave migration.

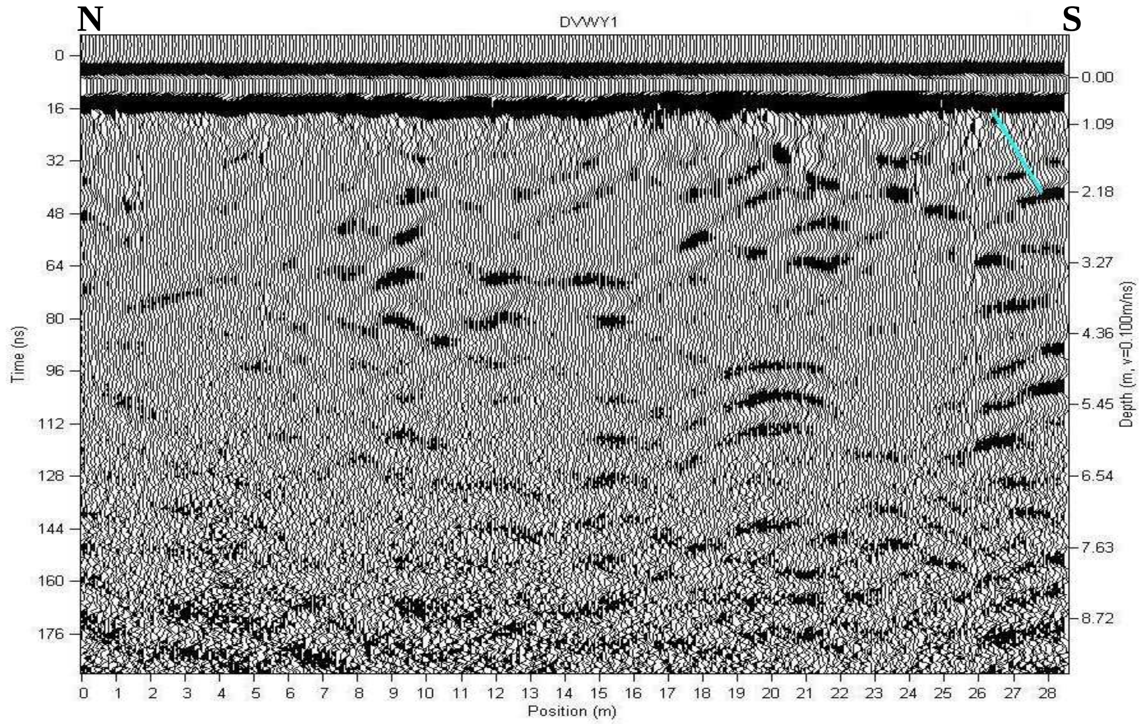


Figure 6.43. DVWY1 Raw Data. The blue line denotes an offset of beds.

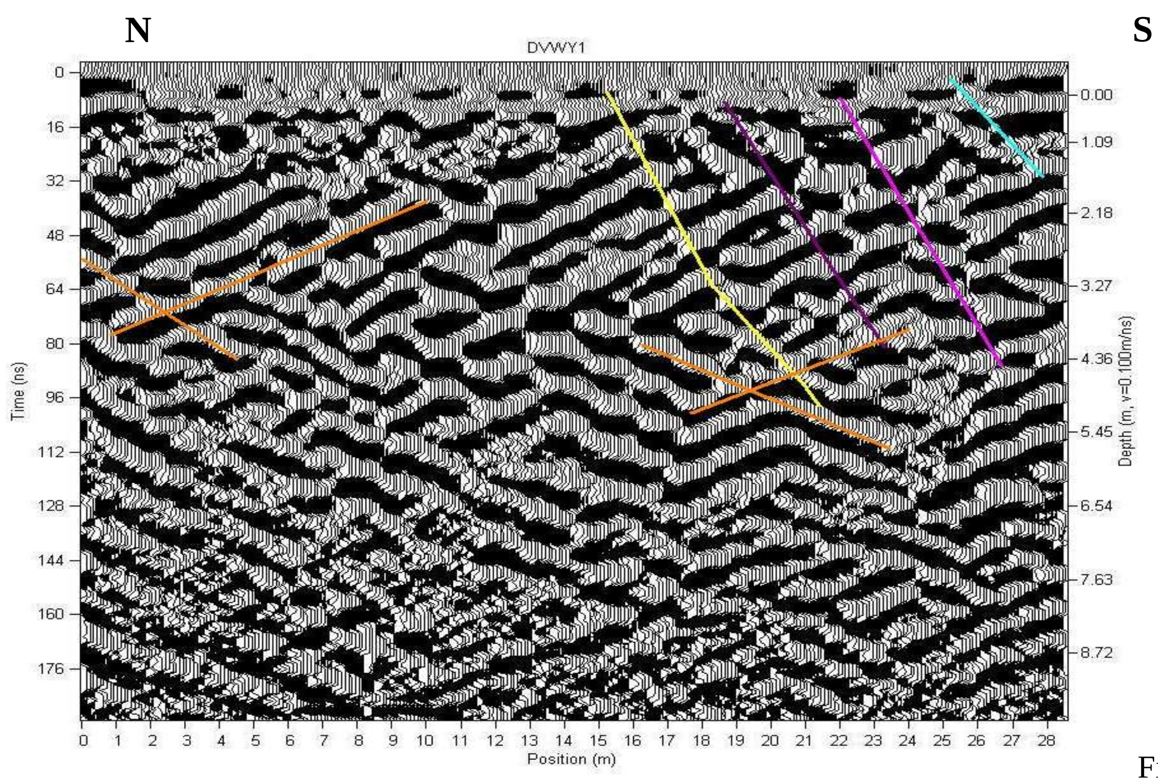


Figure 6.44. DVWY1 Processed data. The yellow, purple, pink and blue lines denote offsets of beds. The bright orange 'X's' outline crossovers observed in this transect.

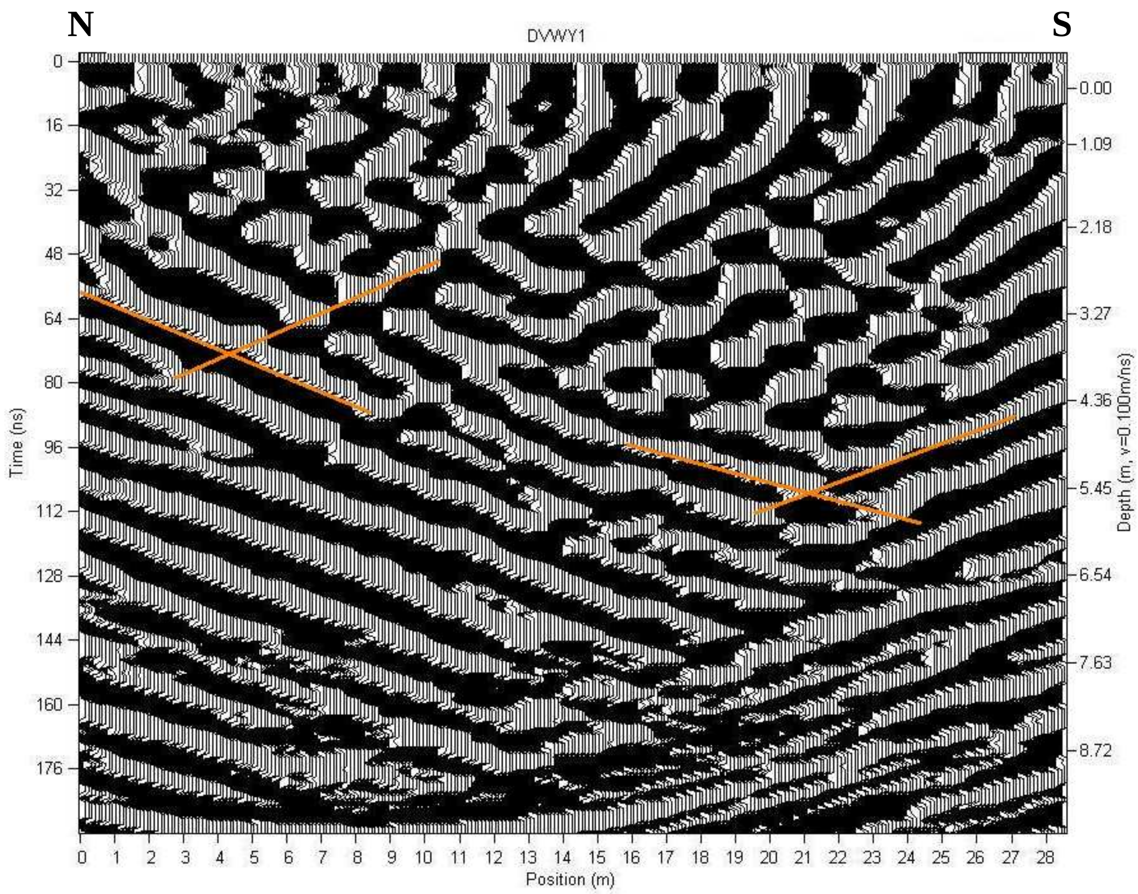


Figure 6.45. DVWY1 Processed Data with a 2-D migration using the air wave velocity, 0.3 m/ns only. The bright orange ‘X’s’ outline crossovers still present in this transect even after the air wave migration.

6.7 Laser Level Measuring Results for Both Field Study Areas

A laser level was used to measure the fault offsets along the onsite structures at both field study areas. The main area of structural damage at the former Woodlawn High School is the Band Room and that is where the laser level data was collected. The main area of structural damage observed at the Glen Oaks High School is along the curbs that border the western driveway of the school.

At the former Woodlawn High School, a transect was measured along the inside west wall of the Band Room where the structural damage appeared to be the worst. Height measurements were collected from the floor up to the laser level line projected, every foot horizontally. Starting at the north end working southwards, height measurements increased along the transect from a minimum value of 86.25 inches (in) to a maximum value of 89.69 in at the corner where the western wall intersects the southern wall. There appeared to be 3.44 inches of subsidence measured along this transect since the school was built back in the late 1950's, early 1960's. This measurement of 3.44 inches would break down to approximately 0.06 inches of movement along the fault per year. If these shallow sediments are 100,000 years old this would break down to a total 6000 in of total movement for this length of time. Figure 6.46a is a sketch of the laser level line data collection set up. Figure 6.46b is a plot of the horizontal distance traveled versus the change in vertical offset. I have assumed in this analysis that the floor was initially level. Figure 6.4 from earlier in this section is a picture of the interior door frame across which the laser level line was taken.

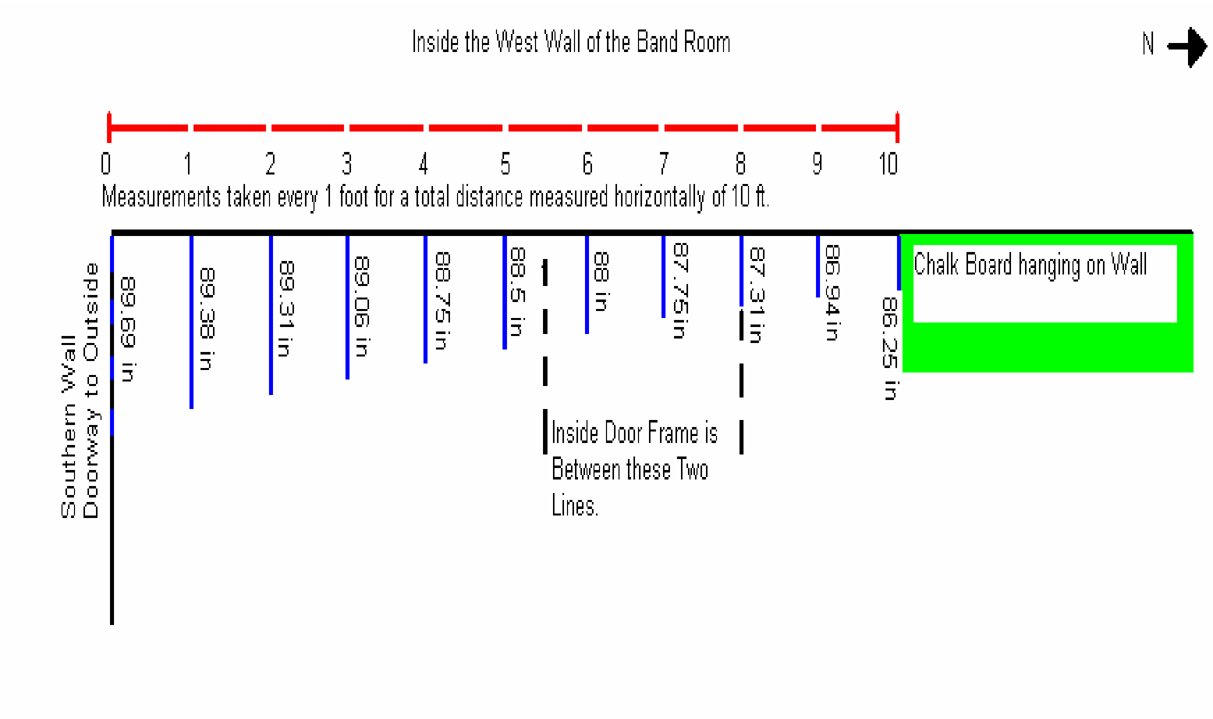


Figure 6.46a. Laser Level line data acquisition inside the west wall of the Band Room at the Former Woodlawn High School.

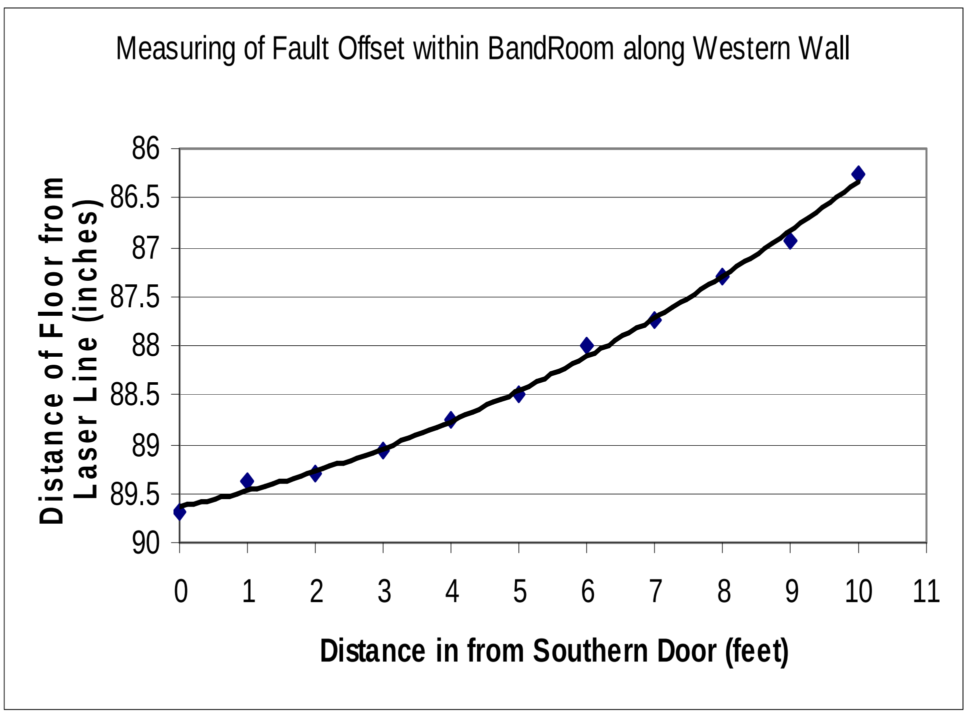


Figure 6.46b. Plot of vertical distance versus the horizontal distance from the floor to the laser level line.

At the Glen Oaks High School, a transect was measured along the eastern curb of the western driveway to the school. Measurements were collected from across the observed offset along the curb, Figure 6.39 in preceding Glen Oaks High School results section. There appeared to be between 2 and 3 inches of subsidence measured in the school which was built back in the late 1950's, early 1960's (East Baton Rouge School Board, personal communication, 2004).

6.8 National Geodetic Survey Benchmark (BM) Results

A total of three 'New Minus Old' (NMO) comparisons were provided by the National Geodetic Survey (NGS). Figure 6.47 is a cumulative figure that shows all three NMO comparison areas overlying contours and LIDAR Digital Elevation Model (DEM) Data. These NMO's contained different level line projects for different years with common benchmarks, and the differences in elevations between these benchmarks in millimeters (mm). The NMO that compares level line projects L24804/1 (1983) to L25082/12 (1987) (Figure 6.48) is just north of the Scotlandville fault, and northeast of the main Baton Rouge industrial area. The NMO that compares level line projects L24133/16 (1976) to L24813 (1984) to L1498 (1934) (Figure 6.49) crosses over the Scotlandville fault only, and is east of the industrial area. This NMO continues on out toward Hammond. However, I have focused on the area near my field study areas which extend out to just past Denham Springs. The NMO that compares level line projects L24133/17 (1977) to L24970 (1986) to L19631 (1964) to L8069 (1938) (Figure 6.50) crosses over the Baton Rouge fault, and is south of the industrial area. This NMO continues on south along the eastern edge of the Mississippi River. However, I have focused on my field study areas. Appendix E shows all the data provided by the NGS.

According to the data provided by the NGS, these NMO comparisons are set up based upon each level line having benchmarks common to a baseline, L24804/1, L24133/16, and

L24133/17, and the first common mark is viewed as equivalent to the elevation of the baseline. Therefore the difference between this first common benchmark and the baseline has a difference of 0.00. Each common point hereafter is the difference in elevations from the first common mark, minus the equivalent difference on the baseline in mm. When the differences in elevation are positive that means that the line compared to the baseline is lower in elevation then the baseline, and when the differences in elevation are negative that means that the line is higher in elevation then the baseline. For a positive difference example if the baseline/1 benchmark has an elevation measurement of 20.45068 m and the line it is compared to differs in elevation by 0.6 mm then the actual vertical elevation for the comparison point is lower in elevation, 20.45008 m. For a negative difference example if the baseline benchmark has an elevation measurement of 18.92233 m and the line it is compared to differs in elevation by -17.24 mm then the actual vertical elevation for the comparison point is higher in elevation, 18.93957. Because each line project is collected at varying levels of accuracy, a direct comparison of their individual Phase I vertical elevation values cannot be made, instead the differences from point to point in comparison to a baseline must be used to determine changes in vertical elevation. The following sections discuss the results from each of these NMO comparisons, how they relate to faults in the area, and if their elevation values vary substantially in relation to their position to the industrial area (cone of depression from groundwater withdrawal).

6.8.1 NMO Comparison between L24804/1 and L25082/12

The L24804/1 (1983 data) line is a second order and first class project, and the L25082/12 (1987 data) line is a second order and second class project. The L24804/1 line was collected at a higher level of accuracy then the L25082/12 line. The baseline for this NMO comparison is L24804/1 and it has elevation values that range from a minimum of 16.71 m to a

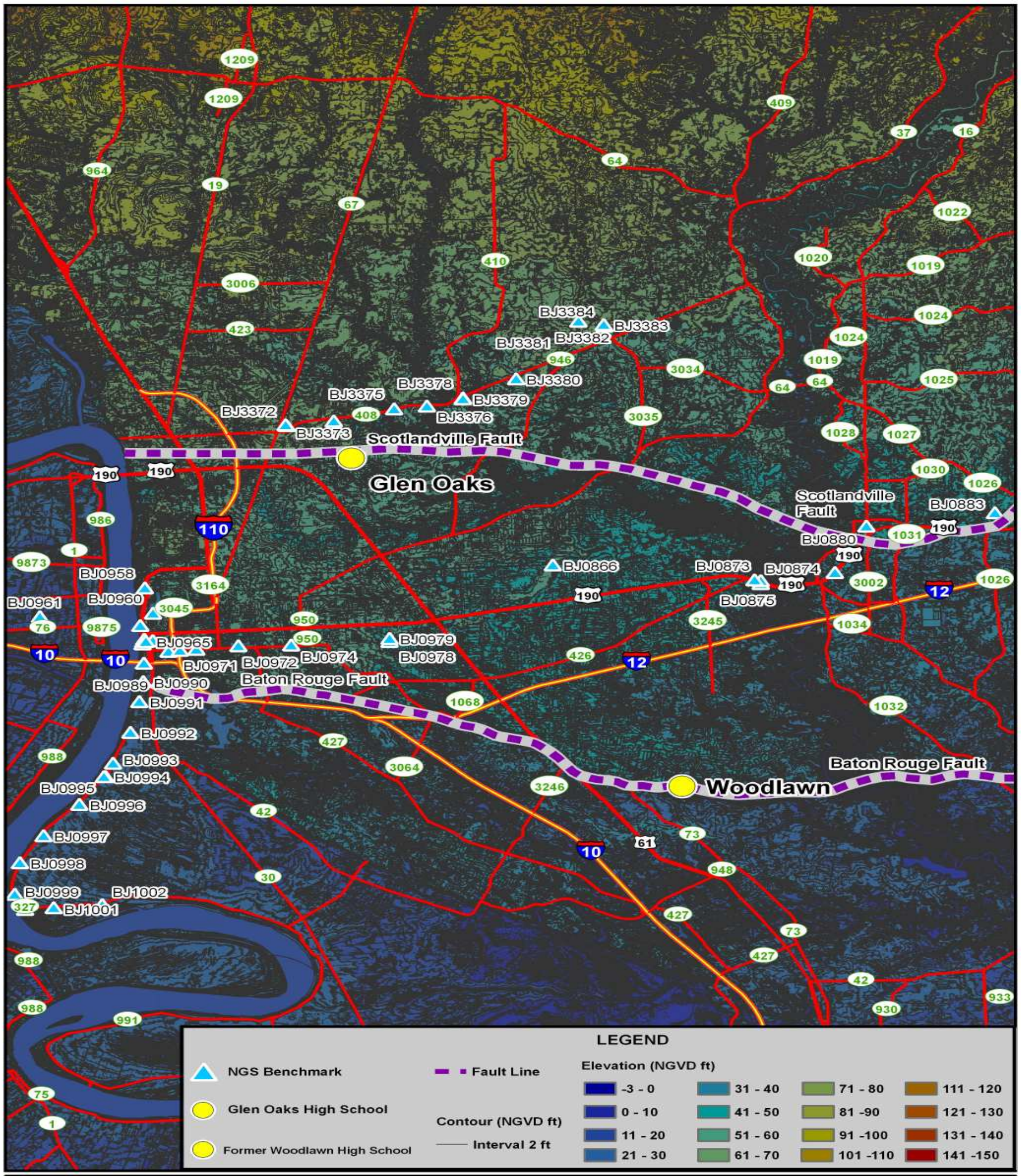


Figure 6.47
NGS BenchMark Locations Overlying Contour and DEM Data

Elevation Data Source: (1998 - 2000) LIDAR data obtained from the Louisiana Federal Emergency Management Agency (FEMA) Project - Task Order 1: Amite River Basin, Louisiana under the St. Louis District U.S. Army Corps of Engineers (USACE) contract number DACW43-98-D-0517.

Figure 6.47 is a composite map that shows all of the NGS Benchmark Locations, both the Scotlandville and Baton Rouge faults and the Glen Oaks and former Woodlawn High Schools overlying LIDAR data in the area.

maximum of 20.45 m for the year 1983. The level line that is compared to this baseline is L25802/12 and ranges in elevation differences from -27.38 mm to 0.6 mm. When comparing these two level lines, years 1983 vs. 1987, as they move away from the industrial area and the Scotlandville fault the elevation difference values get increasingly more negative. Therefore, the 1987 values are higher in elevation than the 1983 values. The difference values are not consistent because in looking at the second BM along the line, it has a positive difference value; therefore lower in elevation compared to the common point 1983 value.

Overall the topography of the area, as seen in Figure 6.48a, is gently rolling with no real strong topographic features present. In contrast, in Figure 6.48b which compares both level line projects, the topography is still gently rolling, but the 1987 data is higher in elevation then the 1983 data. When comparing the two years worth of data based on time, the values are not very different in magnitude since the variations are measured in mm. However, in comparing the 1987 data to the 1983 data, elevation values tend to be on the average approximately 17.5 mm higher in 1987. All benchmarks for this NMO are located north of the Scotlandville Fault and as a whole have moved upward in vertical elevation over time from 1983 to 1987. Also, while looking at the data temporally or spatially, moving away from the industrial area and the fault the actual elevation values or differences in elevation tend to oscillate between highs and lows with a slight general trend to be higher the farther away; therefore, no real apparent spatial trend is present. Table 6.1 shows each BM and corresponding value for each level line project. Figure 6.48 is the NMO that compares L24804/1 (1983) to L25082/12 (1987) overlying contours and the LIDAR digital elevation model data (DEM). Figure 6.48a is a graph of the actual vertical elevation values for the baseline L24804/1. Figure 6.48b is a graph of the differences in vertical elevations of the L25082/1 project versus the baseline L24804/1 project whose values have been zeroed out for comparison purposes.

TABLE 6.1
NMO Comparison Between L24804/1 (yr 1983), and L25082/12 (yr 1987)

How close to Scotlandville fault?	How close to Industry ?	NGS Name	Surveyor's Name	L24804/1 (1983) baseline (m)	Distance from first point in base line LL project (km)	L25082/1 2 (1987) (mm)
Yes	Yes	BJ3372	TAYLOR	20.42919	4.1	0
Yes	Yes	BJ3373	TAYLOR RM 2	20.45068	4.11	0.6
NO	NO	BJ3374	17 V 40	18.92233	5.7	-17.24
NO	NO	BJ3375	17 V 41	17.41767	7.65	-25.31
NO	NO	BJ3376	17 V 42	16.70684	8.71	-25.63
NO	NO	BJ3378	BOLO 3	18.84351	10.09	-27.38
NO	NO	BJ3379	BOLO 3 RM 5	18.90337	10.14	-23.14
NO	NO	BJ3380	17 V 43	18.36274	11.89	-18.57
NO	NO	BJ3381	17 V 44	19.03438	13.66	-19.02
NO	NO	BJ3382	17 V 45	20.43583	15.19	-18.7
Furthest	furthest	BJ3383	SULLIVA N RM 2	19.54583	16.11	-9.43
Furthest	furthest	BJ3384	SULLIVA N	19.37407	16.15	-9.56

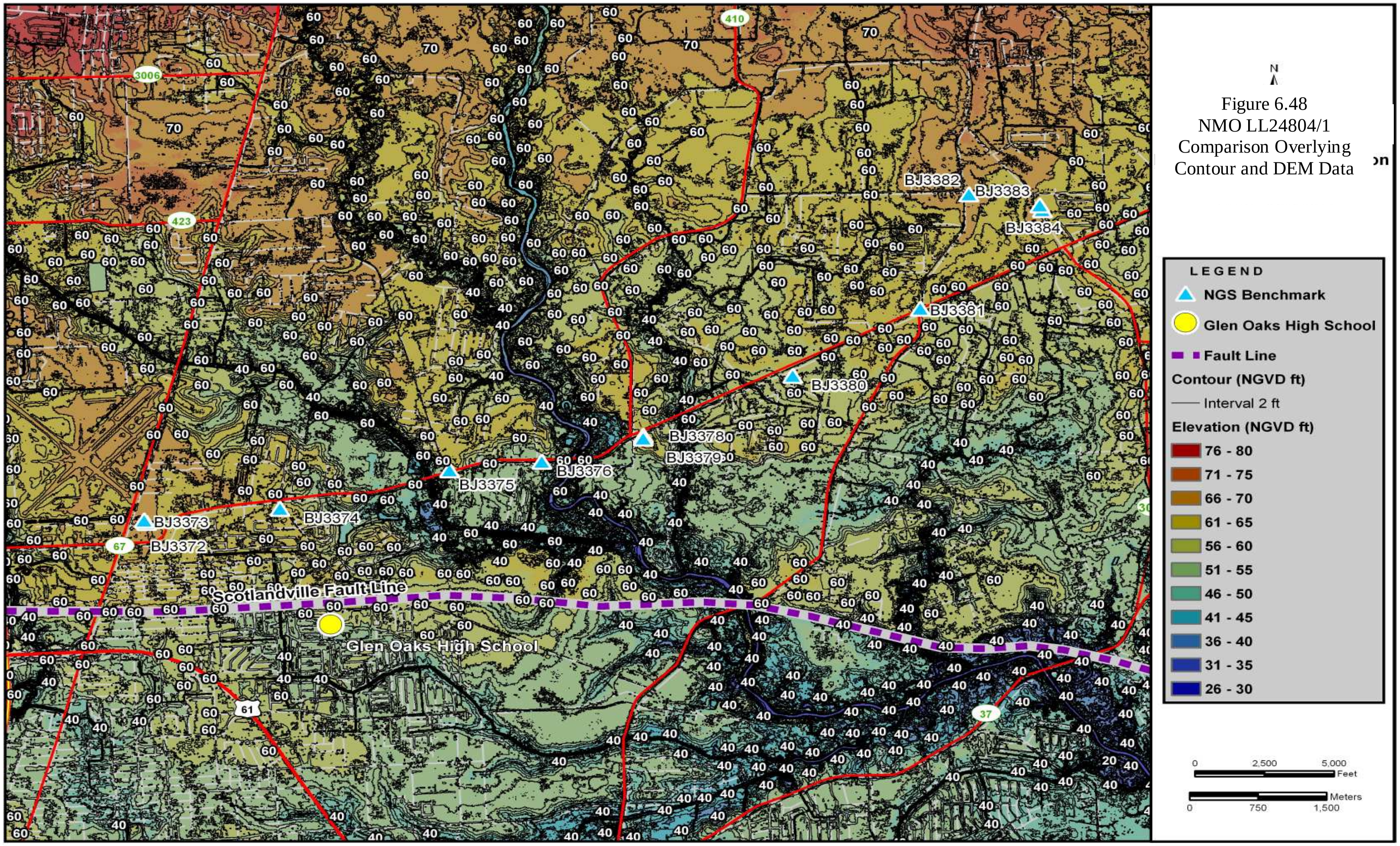


Figure 6.48 is a zoomed in view of the Level Line Project NMO for L24804/1 overlying LIDAR data in the area.

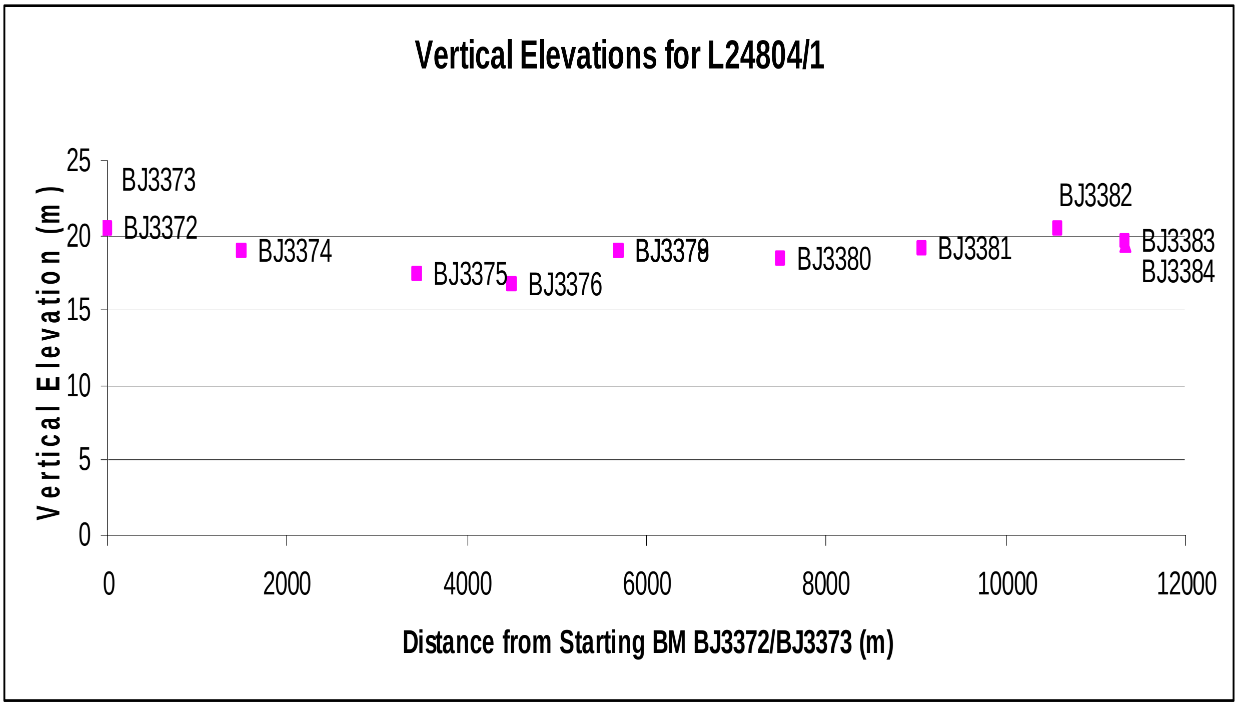


Figure 6.48a. Vertical Elevation values in meters for baseline, L24804/1. The labels on the data points are the actual NGS Benchmark name.

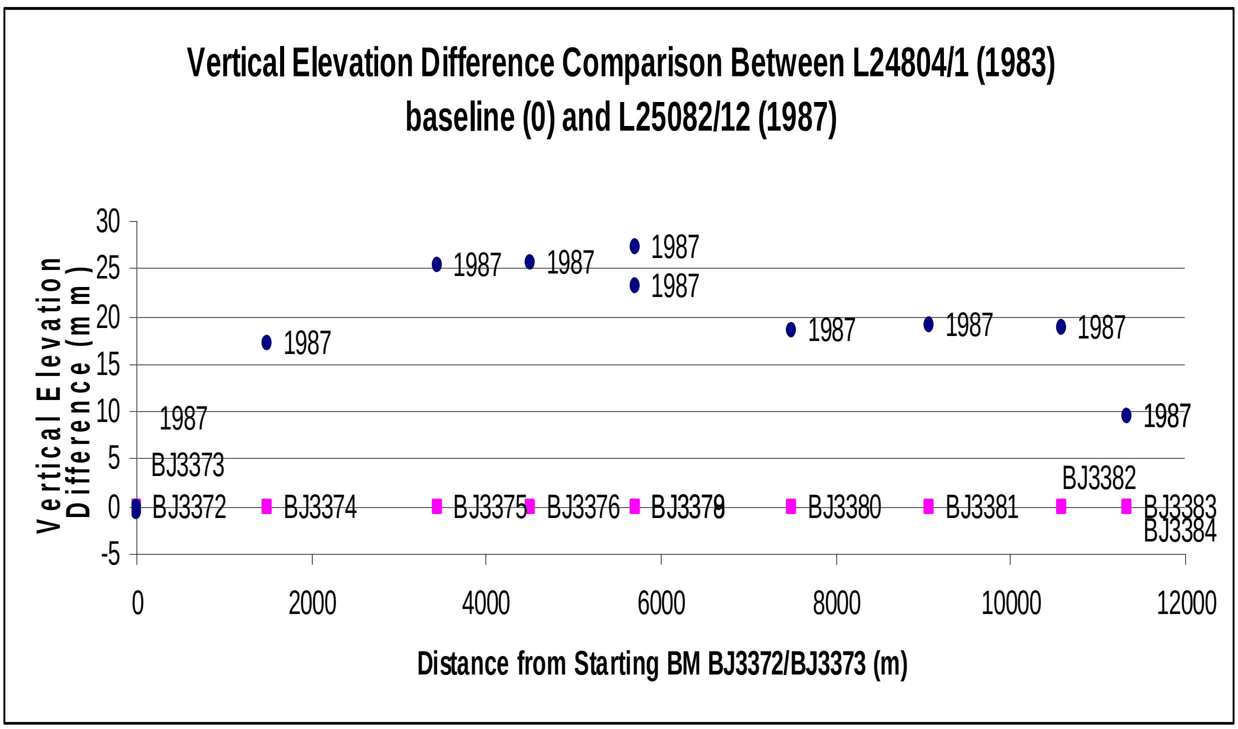


Figure 6.48b. Comparison of Vertical Elevation Difference values in mm with the baseline L24804/1 zeroed out. Those values listed as 1987 in blue are for the L25082/1 line.

6.8.2 NMO Comparison between L24133/16, L24813, and L1498

The L24133/16 line is a first order and first class project, the L24813 line is a second order and first class project, and L1498 is a second order and zero class project. The baseline for this NMO comparison is L24133/16 (1976 data) and it has elevation values that range from a minimum of 11.4 m to a maximum of 15.87 m. The first level line that is compared to the baseline is L24813 (1984 data) and ranges in differences of 17.66 mm to a maximum positive of 29.81 mm. The second line that is compared to the baseline is L1498 (1934 data) and ranges in differences of -114.35 mm to -135.35 mm.

Spatially when comparing the 1976 vs. 1984 data, the elevation values for 1976 and difference values for 1984 tend to increase as approach and cross over the Baton Rouge fault. Since there were only two difference values for the 1934 data, and no corresponding benchmark points with the 1984 data, no direct comparisons were made. However, when looking at the 1976 vs. 1934 data a comparison can only be made with points on the northern side of the fault, moving away from the fault on the northern side the elevation values and difference values tend to increase. Doing the same comparisons as previous but instead looking at the relation to industry, in all three years the values tend to oscillate up and down as move away; however the general trend is to increase. In a spatial sense when doing the comparison of values based on whether they are on the northern or southern sides of the Scotlandville Fault, no real comparisons can be made because of the sparseness in the data.

Temporally when comparing the three years worth of data, the values are not very different in magnitude since the difference variations are measured in mm. However, in comparing the 1984 data to the 1976 data values tend to be on the average 24.72 mm lower in 1984, and in comparing the 1934 data to the 1976 data values tend to be on the average 125.1

mm higher in 1934. So overall as progress through time from 1934 to 1976 on up to 1984, the vertical elevation data values are continuously decreasing in magnitude. Because there is more data on the northern side versus the southern side of the fault, it is difficult to make a determination if the differences in elevation across the fault spatially and temporally are due to subsidence or differential movement. However, it must be noted that the rate of subsidence or differential movement over time is similar, for example on the northern side it is 4-5 times greater in magnitude than on the southern side however at a comparable rate. Table 6.2 shows each BM and corresponding value for each level line project.

TABLE 6.2
NMO Comparison Between L24133/16 (yr 1976), L24813 (yr 1984), and L1498 (yr 1934)

How close to Industry?	How close to Baton Rouge fault?	NGS Name	Surveyor's Name	L24133_16 (1976) Base Line (m)	Dist.from first pt. in baseline project (km)	Difference L24813 (1984) (mm)	Difference L1498 (1934) (mm)
Closest W	furthest S	BJ0866	E 22	15.87417	12.65		0
		BJ0873	STEVENS RESET	11.94732	20.86	0	
		BJ0874	STEVENS RM 3	11.40121	20.87	29.81	
		BJ0875	Q 286	13.16488	21.07	26.69	
	closest S	BJ0877	M 286	11.74921	23.57	17.66	
	closest N	BJ0880	B 22	15.35755	25.83		-114.85
furthest E		BJ0883	TT 7 L USGS	13.61906	29.69		-135.35

Figure 6.49 is the NMO that compares L24133/16 (1976) to both L24813 (1984) and L1498 (1934) overlying contours and the LIDAR DEM data. Figure 6.49a is a graph of the actual vertical elevation values for the baseline L24133/16. Figure 6.49b is a graph of the differences in vertical elevations of the L24813 and L1498 projects versus the baseline L24133/16 project whose values have been zeroed out for comparison purposes.

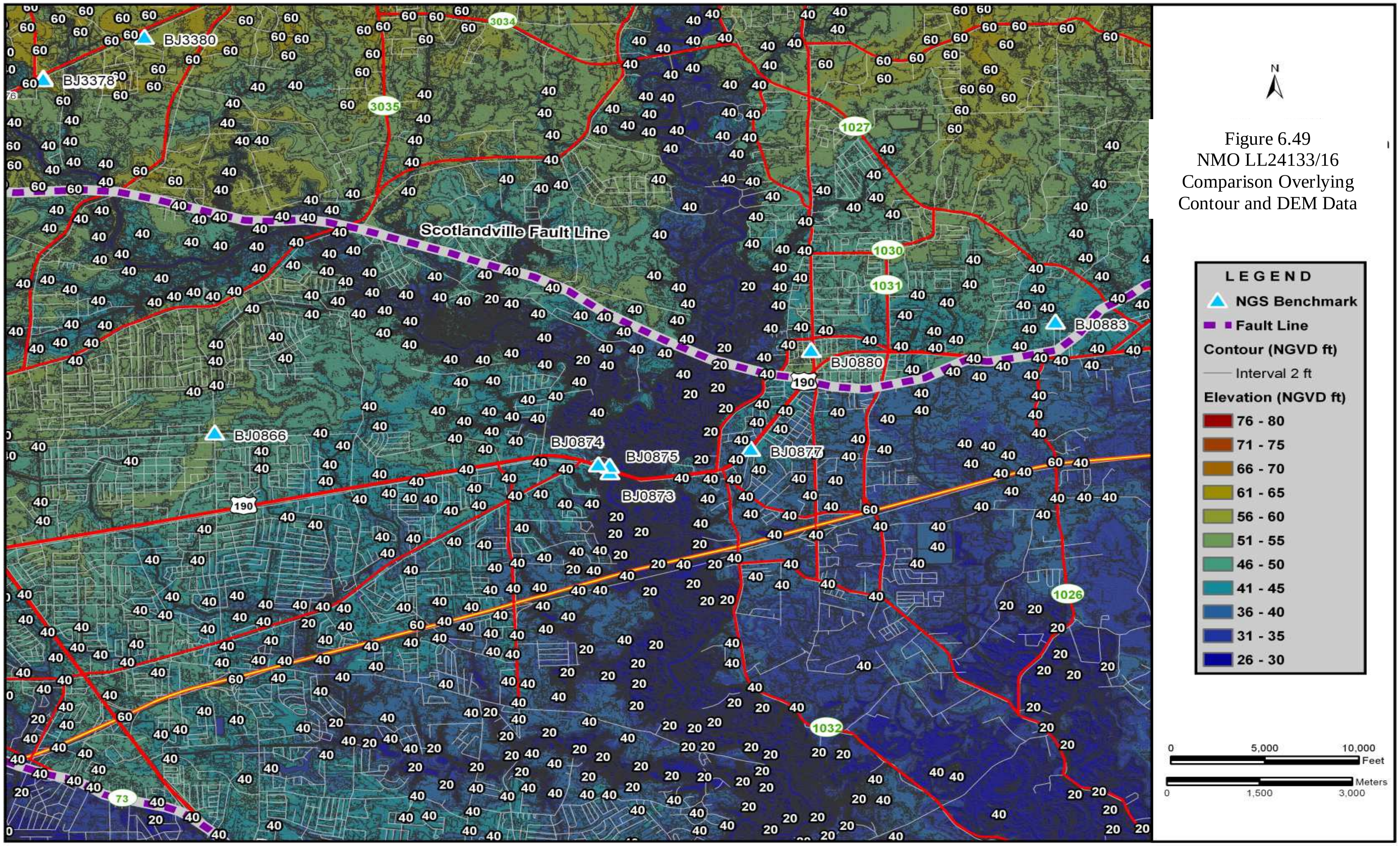


Figure 6.49 is a zoomed in view of the Level Line Project NMO for L24133/16 overlying LIDAR data in the area.

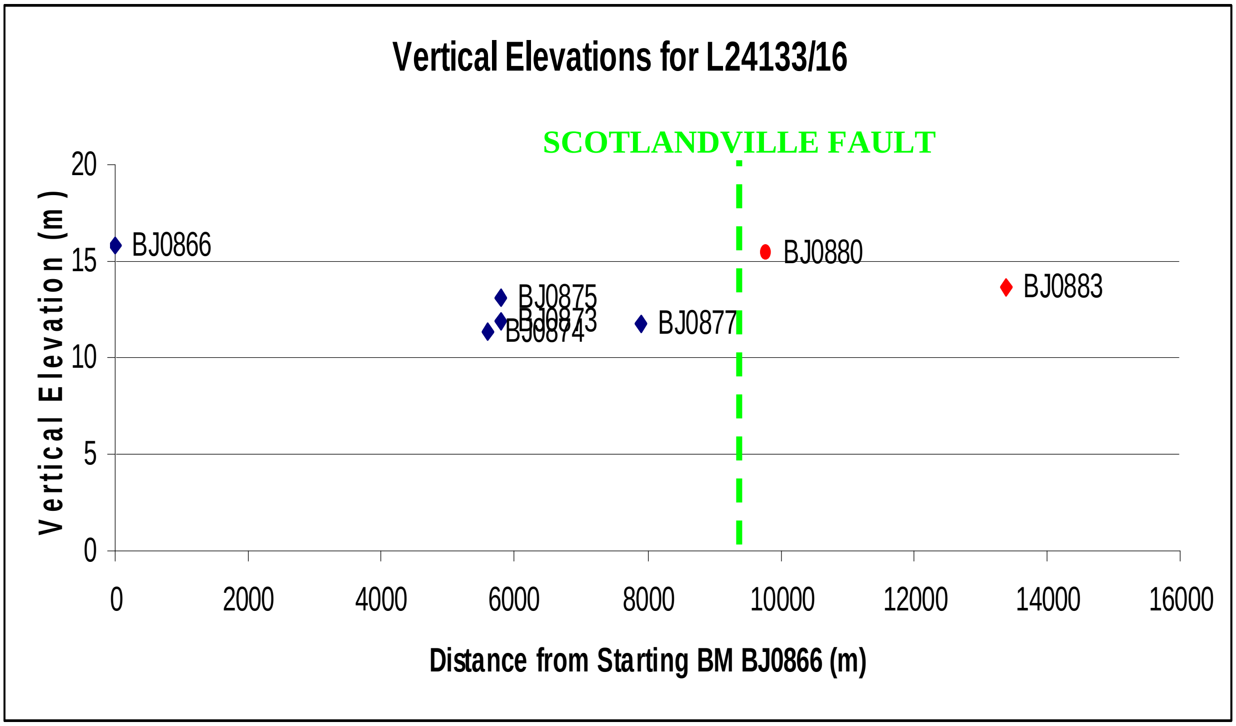


Figure 6.49a. Vertical Elevation values in meters for baseline L24133/16. The labels on the data points are the actual NGS Benchmark name.

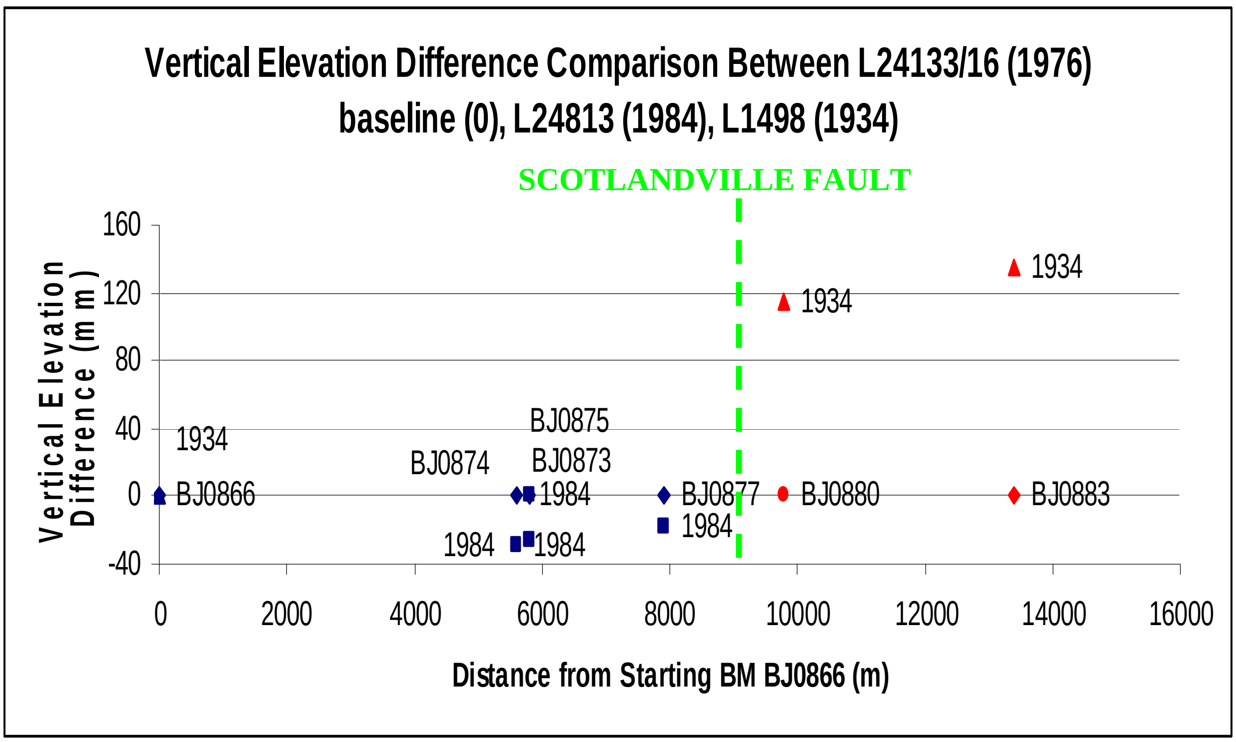


Figure 6.49b. Comparison of Vertical Elevation Difference values in mm with the baseline zeroed out. Those values listed as 1984 with a square symbol are for the L25082/1 line, and those listed as 1934 with a circle symbol are for the L1498 line.

6.8.3 NMO Comparison between L24133/17, L24970, L19631, and L8069

The L24133/17 line is a first order and first class project, and L24970, L19631 and L8069 are all first order and second class projects. The baseline for this NMO comparison is L24133/17 and it has elevation values that range from a minimum of 6.66 m to a maximum of 19.92 m for the year 1977. The first level line that is compared to the baseline is L24970 and ranges in differences of -77.78 mm to a maximum positive of 20.83 mm for the year 1986. The second line that is compared to the baseline is L19631 and ranges in differences of -45.76 mm to a maximum positive of 22.3 mm for the year 1964. The third line that is compared to the baseline is L8069 and ranges in differences of -128.27 to a maximum of -9.86 for the year 1938.

In looking at 1977 data individually, going away from industry there does not appear to be any real trend in the values because they oscillate up and down in value; however, in regards to the Baton Rouge fault, approaching the fault from the northern side the values tend to oscillate up and down in magnitude, the values directly adjacent to the fault north are higher than south. There are two branches to the east of this line project; however, it was determined that the values were similar to those of the line trending north-south adjacent to the Mississippi River; therefore, no further consideration was given to these values. However, all values have been included in Table 6.3.

In looking at 1986 data individually, going away from industry difference values go from positive to negative, however the negative values tend to oscillate up and down. In regards to the Baton Rouge Fault approaching the fault from the north side or the south side difference values oscillate up and down. Once on the southern side of the fault values are higher in elevation compared to the north.

When I compared these level line projects, only the benchmarks that followed along the Mississippi River running north to south were included in the evaluation. The assumption was made that the lines that deviate from the north-south line are similar in magnitude and value to the benchmarks in the same latitudinal area that is included in the north-south line. In a spatial sense when looking at the years of data for the baseline 1977, the vertical elevations are higher on the northern side than on the southern side of the fault; for 1986 the vertical elevations are not very different when comparing the north side to the south side of the fault with one extraneous high point on the southern side; for 1938 there is only one point south of the fault and it is significantly higher then the northern side of the fault; and for 1964 the vertical elevations are also higher on the southern side. Overall when comparing all the years of data with what side of the fault they are on, the 1938, 1964 and 1986 data all show higher vertical elevations on the southern side; however, the 1977 data shows higher vertical elevations on the northern side of the fault. One explanation for these results is that south of the fault there has been rebound in the land surface vertical elevation between the years of 1977 and 1986. This rebound on the southern side could be due to the industrial area still drawing on the deeper aquifers with an area of influence that extends from the southern side of the Scotlandville fault to the northern side of the Baton Rouge Fault. The same type of phenomenon is observed in Nunn (2003) from 1983 to 1987.

Temporally, when looking at the years of data compared to one another on both the northern and southern sides of the fault, the southern side overall has subsided to a greater extent than the northern side up to 1964; however, after 1964 the vertical elevations tend to rebound. The points north of the fault experience a smaller amount of subsidence from the 1930's up to the baseline in 1964, there is no relative change in vertical elevations north of the fault between

1964 and 1977, and in 1986 there does not appear to be any sort of trend in the data. Similar trends are observed on the southern side of the fault when making the same comparisons; however, the furthest southern benchmark evaluated for both the 1938 and 1986 years of data have an anomalous spike in their vertical elevation values. When comparing both spatially and temporally between the 4 lines, those values north of the fault do not vary much with those south of the fault. However, when comparing both spatially and temporally between those lines compared to the baseline, the difference values north of the fault are much smaller then those to the south. Table 6.3 shows each BM and corresponding value for each level line project.

Figure 6.50 is the NMO that compares L24133/17 (1977) to L24970 (1986), L19631 (1964) and L8089 (1938) overlying contours and LIDAR DEM data. Figure 6.50a is a graph of the actual vertical elevations for the baseline L24133/17. Figure 6.50b is a graph of the differences in vertical elevations of L24970, L19631 and L8089 projects versus the baseline L24133/17 project whose values have been zeroed out for comparison purposes.

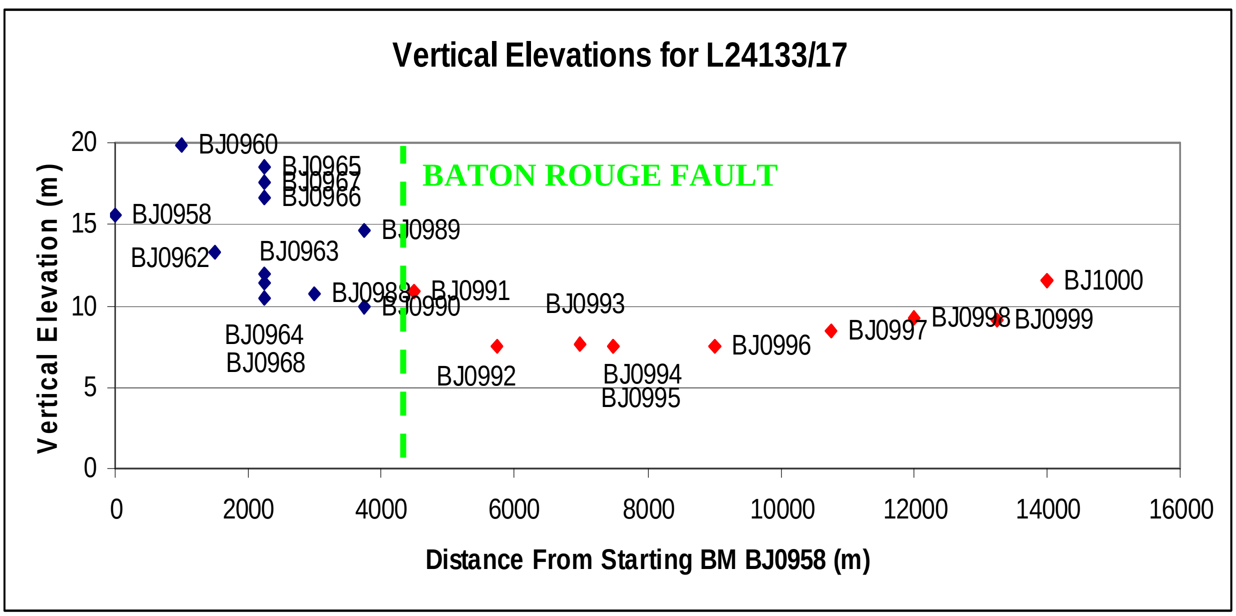


Figure 6.50a. Comparison of actual Vertical Elevation values in meters. The labels on the data points are the actual NGS Benchmark name.

TABLE 6.3
NMO Comparison Between L24133/17 (yr 1977), L249709 (yr 1986), L19631 (yr 1964), and L8069 (yr 1938)

How close to Industry?	How close to Baton Rouge fault?	NGS Name	Surveyor's Name	L24133_17 (1977) Base Line values (m)	Distance from first point in base line LL project (km)	Difference L24970 (1986) (mm)	Difference L19631 (1964) (mm)	Difference L8069 (1938) (mm)
Closest	furthest N	BJ0958	J 22	15.54953	0.22	0		
Closest		BJ0960	L 22	19.92023	1.47		0	0
Furthest W	furthest W	BJ0961	17 B 013	16.10786	1.73	20.83		
		BJ0962	C 204	13.27296	2.14	-42.36		
		BJ0963	B 197 WELL	10.50777	2.75		-3.98	
		BJ0964	2	11.43851	2.84		9.19	-9.86
		BJ0965	XXXI	18.54422	3.01		-3.14	-34.92
		BJ0966	NORTH BOULEVARD CAP	16.70007	3.17		22.3	-22.25
		BJ0967	POST OFFICE	17.6248	3.2		7.16	-24.06
		BJ0968	K 22	12.00813	2.95		2.2	-28.83
		BJ0969	M 197	11.22538	3.95		-1.94	
		BJ0970	N 197	15.05684	4.35		1.47	
		BJ0971	P 197	17.06767	4.87		-1.98	
		BJ0972	Q 197	13.41981	6.23		-2.02	
		BJ0974	R 197 WELL	15.53009	7.96		-12.17	
		BJ0975	W 197	16.84317	8.79		-11.79	
Furthest E	furthest E	BJ0978	U 197	15.9702	11.17		-16.38	
Furthest E	furthest E	BJ0979	V 197	15.65466	11.27		-10.54	
		BJ0988	J 288	10.72699	3.76	-5.56		
	Closest N	BJ0989	C 198	14.59654	5.2		-15.43	
	Closest N	BJ0990	K 288	9.88917	4.53	-26.6		
	Closest S	BJ0991	D 197	10.93628	5.42	-21.89	10.34	

TABLE 6.3 (Cont.)

How close to Industry?	How close to Baton Rouge fault?	NGS Name	Surveyor's Name	L24133_17 (1977) Base Line values (m)	Distance from first point in base line LL project (km)	Difference L24970 (1986) (mm)	Difference L19631 (1964) (mm)	Difference L8069 (1938) (mm)
	Closest S	BJ0992	C 927 LAGS	7.57856	6.7		-8.71	
		BJ0993	C 929	7.59583	8.08	-23.52	-32.35	
		BJ0994	C 930	7.45662	8.63	-14.52	-33.64	
		BJ0995	ARLINGTON CAP RESET	7.51859	8.67	-19.64	-23.59	
		BJ0996	B 198	7.46716	10.05	-13.4	-45.76	
		BJ0997	W 94 RESET	8.42031	11.71	-8.31	-37.78	
		BJ0998	C 936	9.22653	13.04	-77.76	-33.43	
Furthest S	furthest S	BJ0999	XXV11	9.16909	14.37		-16.52	-128.27
Furthest S	furthest S	BJ1000	C 940	11.53978	15.11		-17.74	
Furthest S	furthest S	BJ1001	E 197	8.75665	16.07	-10.93	-15.83	
Furthest S	furthest S	BJ1002	C 944	12.67568	17.63		-6.6	
		BJ1003	L 197 RESET	6.65683	19.35	-20.17		
		BJ1004	K 197 RESET	7.35094	20.8	-35.14		

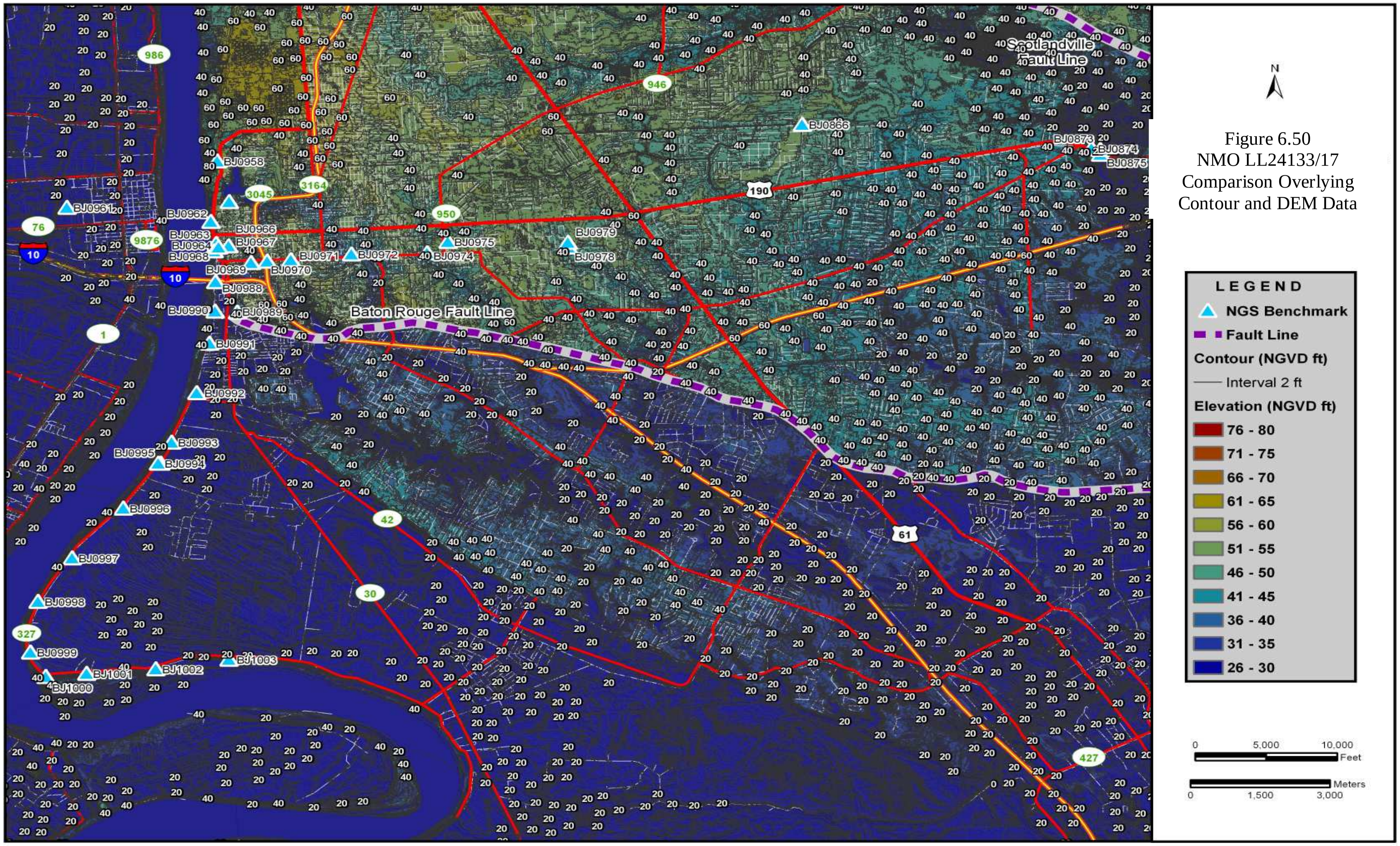


Figure 6.50 is a zoomed in view of the Level Line Project NMO for L24133/17 overlying LIDAR data in the area.

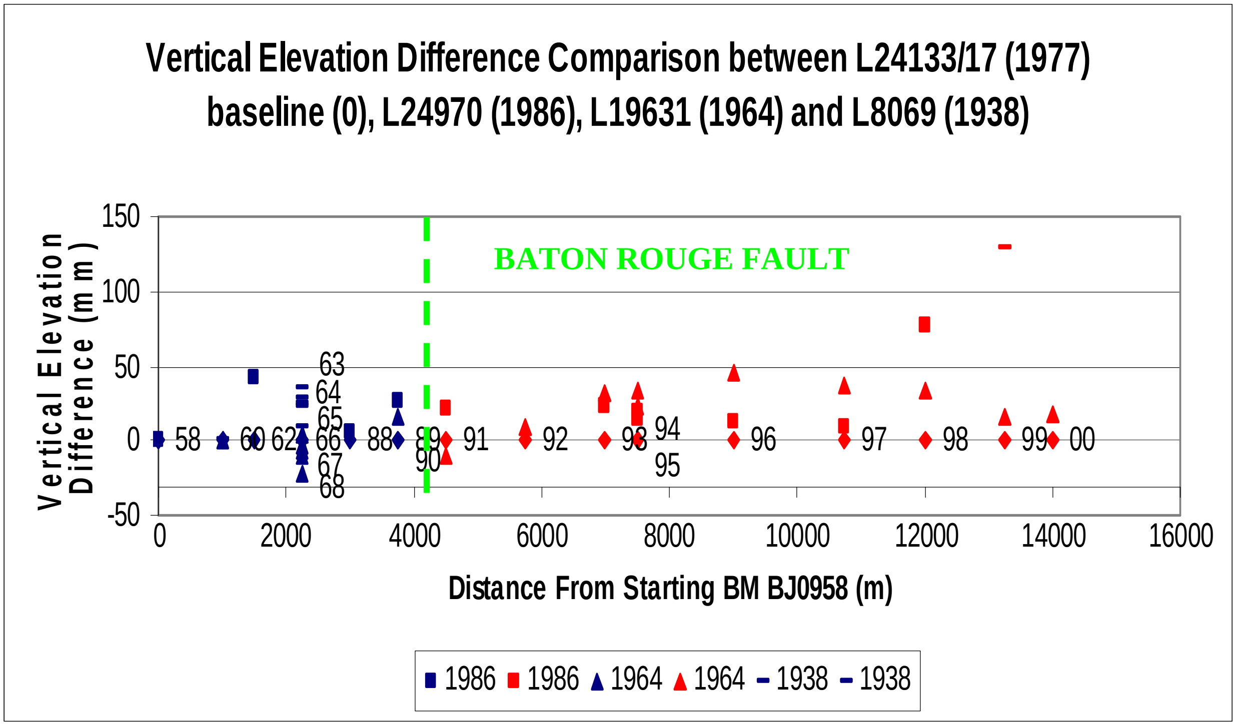


Figure 6.50b. Comparison of Vertical Elevation Difference values in mm with the baseline zeroed out. The baseline values are labeled only with the last two digits of the NGS Benchmark name. Those values with a square symbol are for the L24970 line, 1986 year data, those with a triangle symbol are for the L19631 line, 1964 year data, and those with a dash are for the L8069 line, 1938 year data.

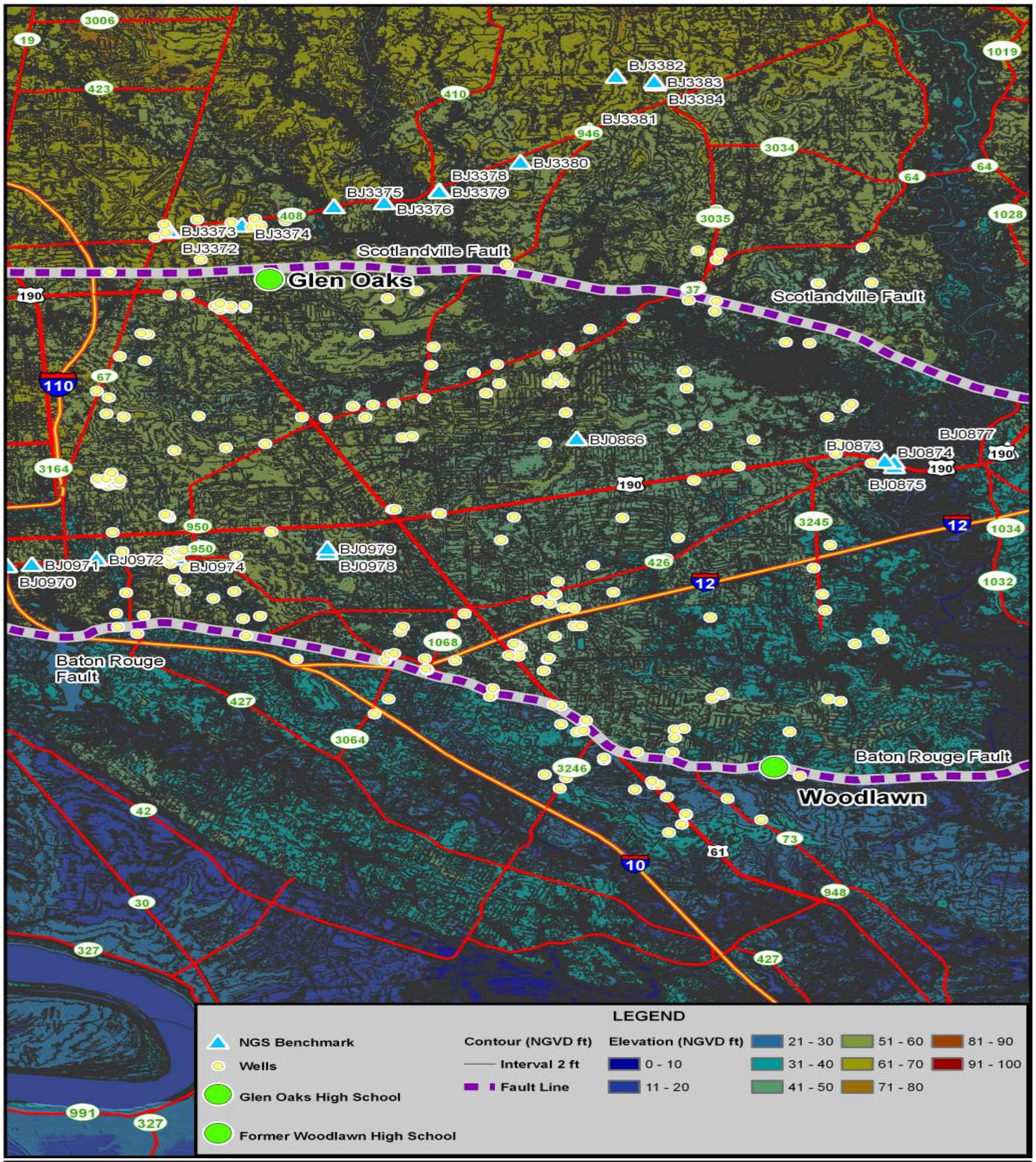


Figure 6.51
USGS Wells and NGS BenchMark Locations Overlying Contour and DEM Data

Elevation Data Source: (1998 - 2000) LIDAR data obtained from the Louisiana Federal Emergency Management Agency (FEMA) Project Task Order 1: Amite River Basin, Louisiana under the St. Louis District U.S. Army Corps of Engineers (USACE) contract number DACW43-98-D-0517.

N

0 2,500 5,000 10,000 Feet

0 1,000 2,000 4,000 Meters

Figure 6.51 is a composite map that shows all of the USGS Wells, the NGS Benchmarks in the same area, both the Scotlandville and Baton Rouge faults and the Glen Oaks and former Woodlawn High Schools overlying LIDAR data in the area.

6.9 USGS Hydrogeology Results

The 5 main drinking water aquifers as outlined in Chapter 3 are the 1200 ft Sand, the 1500 ft Sand, the 2000 ft Sand, the 2400 ft Sand and the 2800 ft Sand. A table including all wells, their years of groundwater elevation data and their corresponding elevation values, in the area of both the former Woodlawn High School and the Glen Oaks High School is included as Appendix G. Appendix H has the hydrographs that correspond to these same wells. The groundwater elevation values in both Appendix G and H that are negative are above ground surface (artesian wells); those values that are positive are below ground surface. The majority of wells in close proximity to the field study areas are screened in the shallow aquifers (e.g. the 1000 ft Sand, 800 ft Sand, 600 ft Sand, 400 ft Sand or the Shallow Sands). Using Figure 6.51 which combines USGS wells, NGS benchmark locations, contours and LIDAR DEM data, I reviewed the well locations and years of data for each main aquifer and their relative locations to the field study areas and faults. Figure 6.51 does not have the USGS wells actually labeled because the figure is already overwhelmed with detail; however, once the figure is enlarged the well labels appear.

6.9.1 Former Woodlawn High School Hydrogeology Results

Adjacent to the former Woodlawn High School study area, the major concentrations of wells in the area are to the northwest and southwest, with little to no wells at all directly north, south, northeast or southeast. In evaluating each of the aquifers, there were some that had wells in close proximity to both the school and Baton Rouge fault and others that had the closest well to be a significant distance away from both the school and fault. Figure 6.52 combines the former Woodlawn High School field study area, USGS wells, contours and LIDAR DEM data.

Of the main aquifers the shallowest is the 1200 ft Sand. There were no wells screened in the 1200 ft Sand in close proximity to either the former Woodlawn High School or the Baton Rouge fault, and only one at a significant distance (Figure 6.52). USGS well EB- 990 was the closest 1200 ft Sand well, at an approximate distance of 17,500 ft from the school to the northwest and approximately 3500 ft directly north of the fault. In comparing values for EB-990 in 1990 vs. 2001, the 1990 value of 81.45 ft bls is shallower then the 109.31 ft bls of 2001. There were approximately 12 additional wells that were in the general area of the school, and their groundwater levels compared closely to the EB-990 well.

There has been a gradual decline in water levels with time within the 1200 ft Sand aquifer in the area of the former Woodlawn High School, as seen in Figure 6.52a. However, since there is only one well south of the fault with only one data point, no real comparison can be made between groundwater levels north versus south of the Baton Rouge fault.

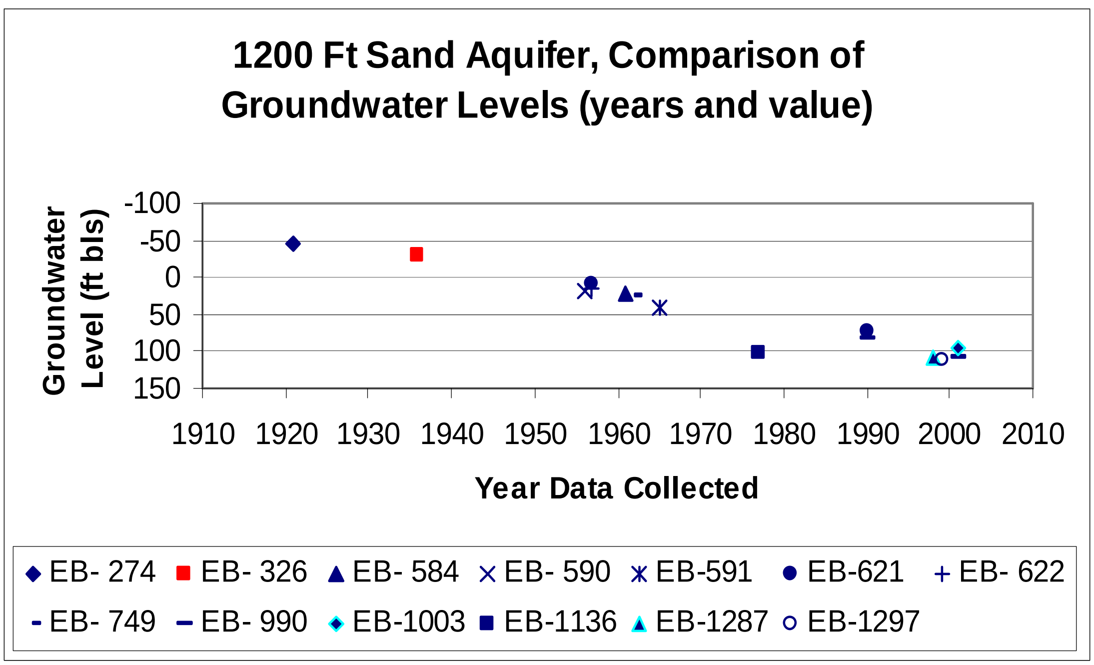


Figure 6.52a. This hydrograph not only compares different wells but also the years of different elevation data for each well within the 1200 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Baton Rouge fault are shown in red.

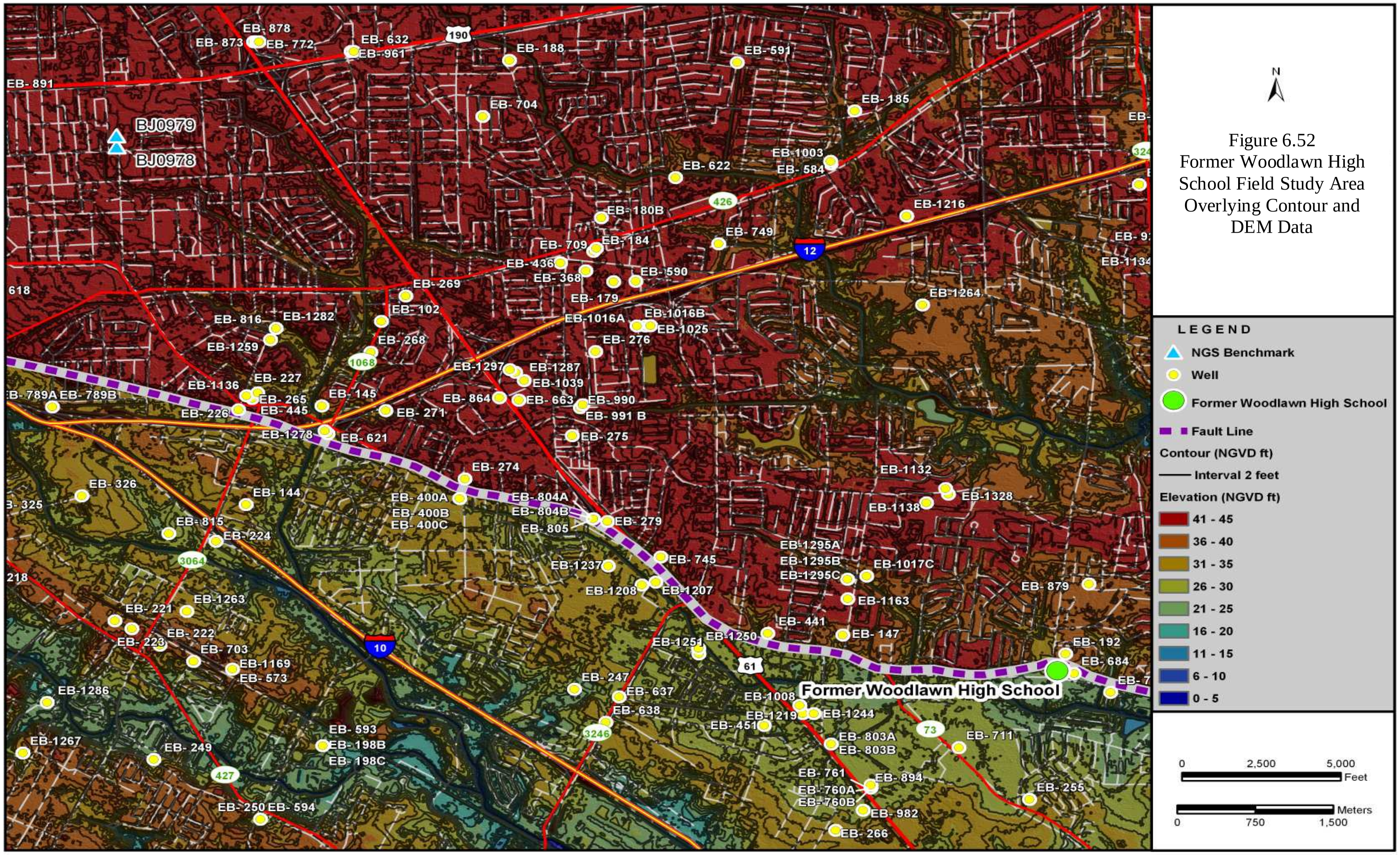


Figure 6.52 is a zoomed in view of the former Woodlawn High School and USGS wells in the area overlying LIDAR data in the area.

There are a total of two wells screened in the 1500 ft Sand aquifer in the proximity of the school and fault (Figure 6.52). USGS well EB- 803A is at an approximate distance of 7000 ft from the school to the southwest and approximately 3000 ft directly south of the fault. USGS well EB-1295 is at an approximate distance of 7500 ft from the school to the northwest and approximately 3500 ft directly north of the fault.

When comparing the different years of data for EB- 803A, it must be noted that the values are averaged because of multiple measurements taken within each year. Overall the values start out negative in 1966 but decrease in negativity up through 1970, then values continue to increase into the positive range. There has been a gradual decline in water levels with time within the 1500 Ft Sand, as seen in Figure 6.52b.

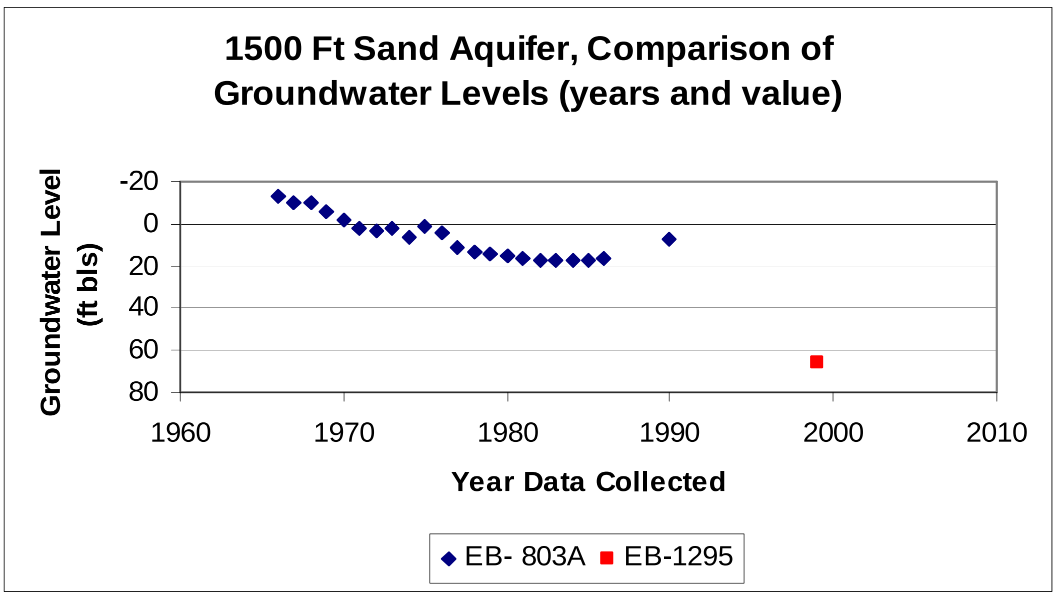


Figure 6.52b. This hydrograph not only compares different wells but also the years of different elevation data for each well within the 1500 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Baton Rouge fault are shown in red.

There are a total of two wells screened in the 2000 ft Sand aquifer in the proximity of the both the school and fault (Figure 6.52). USGS well EB- 803B is at an approximate distance of

7000 ft from the school to the southwest and approximately 3000 ft directly south of the fault. USGS well EB- 878 is at an approximate distance of 35,000 ft from the school to the northwest and approximately 14,000 ft directly north of the fault.

The comparison between wells EB- 803B and EB- 878 shows only one year of data that matches up, 1971. The 1971 data for EB- 803B has been averaged because of multiple measurements that were taken during this year. When comparing groundwater elevations for EB-878 (northern well) to EB-803B (southern well), the northern side is significantly lower than the southern side. EB- 878 has a value of 203 ft bls vs. a value of -34.9 ft bls at EB- 803B (artesian well). There has been a gradual decline in water levels with time within the 2000 Ft Sand, as seen in Figure 6.52c. However, since there is only one well north of the fault with only two data points, no real comparison can be made between groundwater levels north versus south of the fault.

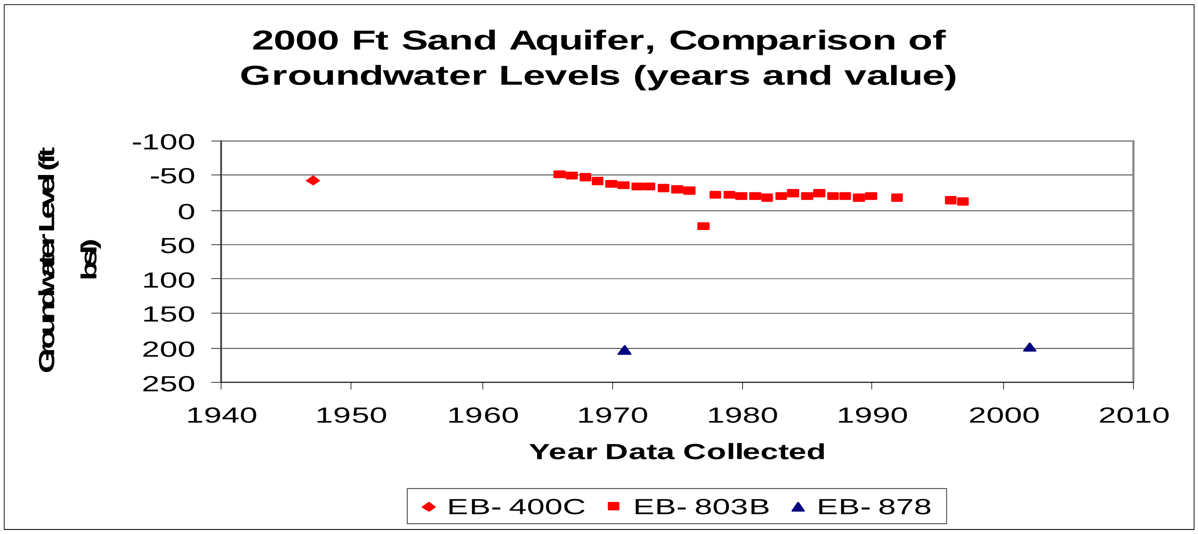


Figure 6.52c. This hydrograph not only compares different wells but also the years of different elevation data for each well within the 2000 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Baton Rouge fault are shown in red.

There are a total of three wells screened in the 2400 ft Sand aquifer in the proximity of the former Woodlawn High School area (Figure 6.52). USGS well EB-804B is at an approximate distance of 16,000 ft from the school to the northwest and directly adjacent to the north of the fault. USGS well EB-1025 is at an approximate distance of 17,500 ft from the school to the northwest and approximately 8750 ft directly north of the fault. USGS well EB-400A is at an approximate distance of 20,000 ft from the school to the northwest and directly adjacent to the south of the fault. There has been a gradual decline in water levels with time within the 2400 Ft Sand, as seen in Figure 6.52d. However, since there is only one well south of the fault with only one data point, no real comparison can be made between groundwater levels north versus south of the fault.

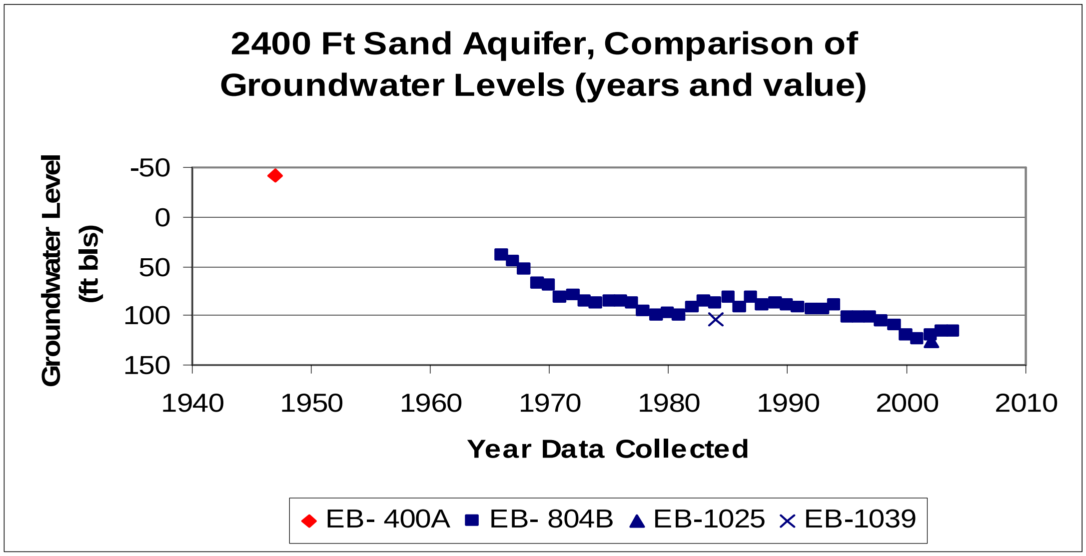


Figure 6.52d. This hydrograph not only compares different wells but also the years of different elevation data for each well within the 2400 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Baton Rouge fault are shown in red.

The final deep main aquifer is the 2800 ft Sand, where only one well is screened in the area of the school and faultide. USGS well EB-400B is at an approximate distance of 20,000 ft from the school to the northwest and directly adjacent south of the fault. EB-400B has groundwater elevation data for only one year, 1947. Because there is only one well in the area, and only one year of data for this well, no comparisons of data can be made; therefore, no determination on impact of the 2800 ft Sand groundwater on the subsidence along the fault can be made.

6.9.2 Glen Oaks High School Hydrogeology Results

Glen Oaks High School appears to have an even split of shallow minor aquifer wells and deeper main aquifer wells. The wells appear to be spread out around Glen Oaks High School, with only a data gap observed towards the northeast as far as close proximity wells. In evaluating each of the aquifers, there were some that had wells in close proximity to both the school and Scotlandville fault and others that had the closest well to be a significant distance away from both the school and fault. It must be noted that due to the groundwater cone of depression in many of the main aquifers being so spread out and gently sloping, that those wells that are further away from Glen Oaks are still ok to be used. Figure 6.53 combines the Glen Oaks High School field study area, USGS wells, contours and LIDAR DEM data.

There are a total of six wells screened in the 1200 ft Sand aquifer in close proximity to both the Glen Oaks High School and the Scotlandville Fault, as seen in Figure 6.53. USGS Well EB- 455 is the closest 1200 ft Sand well at an approximate distance of 4375 ft from the school to the northwest, and approximately 1750 ft directly north of the fault. Well EB- 342 was the second closest 1200 ft Sand well at an approximate distance of 5250 ft from both the school and fault, directly north of both. Well EB-343 was the furthest 1200 ft Sand well at an approximate distance of 6125 ft from the school to the northwest, and approximately 3500 ft directly north of the fault. There has been a gradual decline of water levels up till the 1940's then a drastic decline up to the 1960's then is gradual up to the present, as seen in Figure 6.53a.

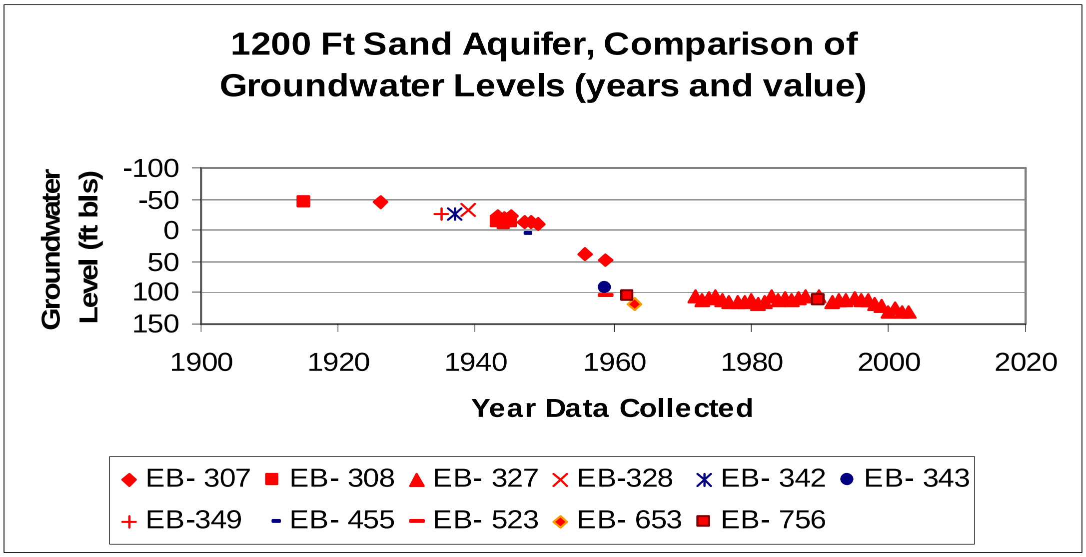


Figure 6.53a. This hydrograph not only compares different wells but also the years of different elevation data for each well within the 1200 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Scotlandville fault are shown in red.

There are a total of three wells screened in the 1500 ft Sand aquifer in the area of both the school and fault, as seen in Figure 6.53. USGS Well EB- 373 is the closest 1500 ft Sand well at an approximate distance of 7875 ft from the school to the northwest, and approximately 3500 ft directly north of the fault. Well EB-374 is the second closest 1200 ft Sand well at an approximate distance of 10,500 ft from the school to the northwest, and approximately almost on the fault line to the north. Well EB- 443 is the third closest 1200 ft Sand well at an approximate distance of 10,000 ft from the school to the southwest, and approximately 5250 ft directly south of the fault. Well EB- 312 was the furthest 1200 ft Sand well at an approximate distance of 10,600 ft from the school to the southwest, and approximately 8750 ft directly south of the fault.

The comparison of wells EB-373 and EB-374 to EB-312 shows that each well has one year of data that can be compared with EB-312 data. Even though the USGS data shows that EB- 373 has data for 1944 and EB- 443 has data for 1946, in reality there is only a comment listed where the value should be recorded, which states no measurement because site was flowing and therefore no comparison can be made with EB- 312 (Appendix G).

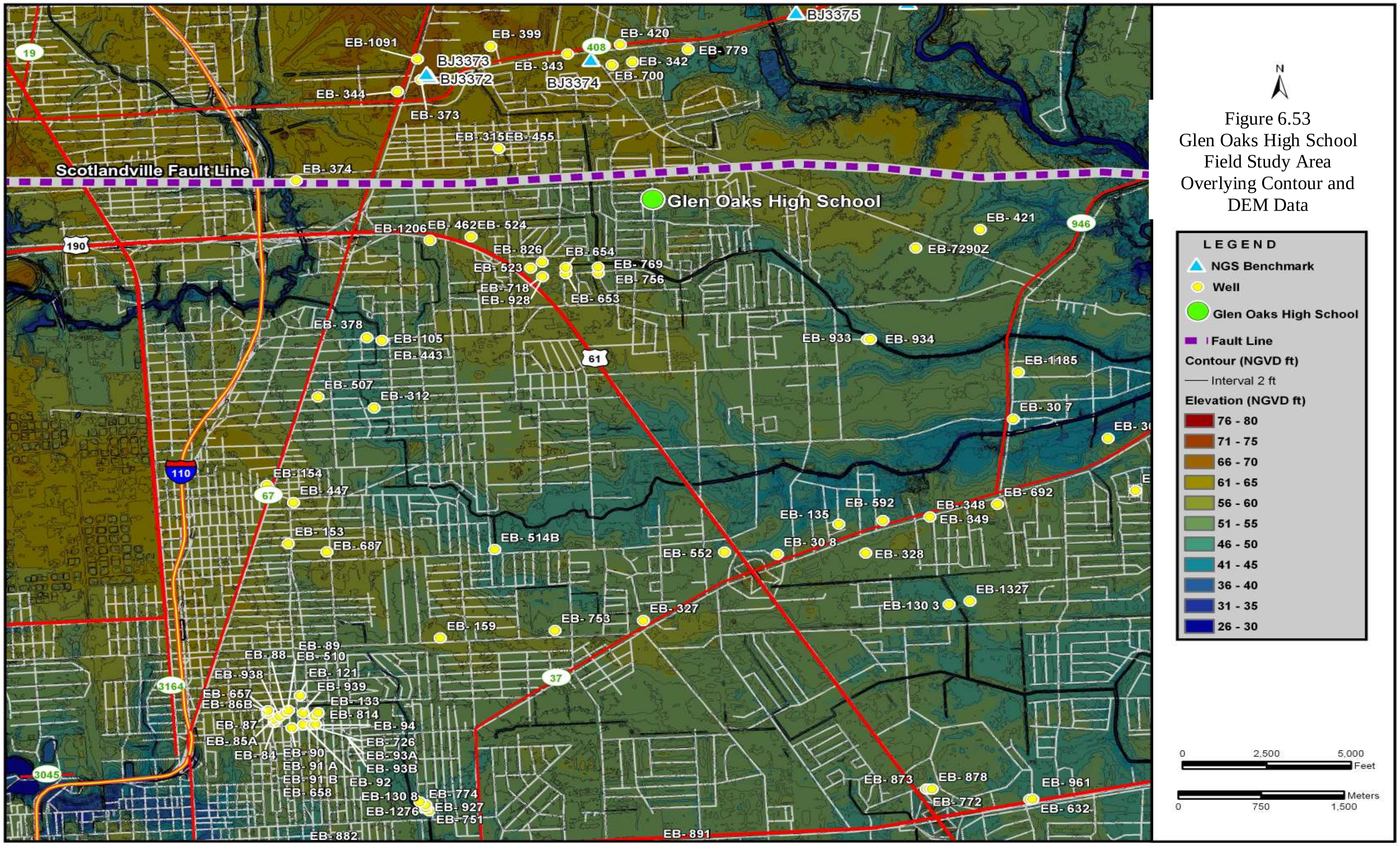


Figure 6.53 is a zoomed in view of the Glen Oaks High School and USGS wells in the area overlying LIDAR data in the area.

Except for the 1925 data which only has one value posted, all data has been averaged for EB-312 because of multiple measurements that were taken during these years. When comparing EB-374 to EB-312 which are both north of the fault for the year 1949, the depth to groundwater is deeper at EB-374 and shallower at EB-312. When comparing the different years of data for EB- 312 and the rest of the wells included in Figure 6.53b, there has been a gradual decline of water levels up till the 1940's then a drastic decline up to the 1960's then is gradual up to the present.

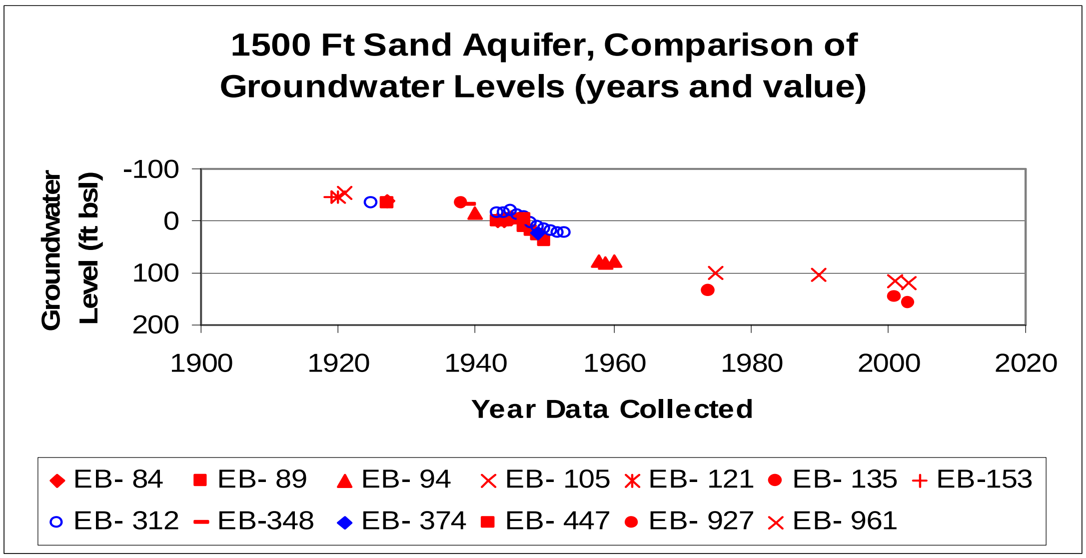


Figure 6.53b. This hydrograph not only compares different wells but also the years of different elevation data for each well within the 1500 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Scotlandville fault are shown in red.

There are two wells screened in the 2000 ft Sand aquifer in the area of both the school and fault, as seen in Figure 6.53. USGS Well EB- 315 is the closest 2000 ft Sand well at an approximate distance of 5250 ft from the school to the northwest, and approximately 875 ft directly north of the fault. Well EB-774 is the furthest 2000 ft Sand well at an approximate distance of 22,750 ft from both the school and fault to the south.

When comparing the different years of data for EB- 315, it must be noted that the values are averaged because of multiple measurements taken within each year. Values start out negative (artesian setting) in 1938 but the overall trend is a decrease in negativity up through 1945 (decline in water level), and then the value trend is to continue to increase into the positive range on up to the very end in 1956. When comparing the different years of data for EB- 774, the trend is declining from 1964 to a maximum low value in 2002. There has been a drastic decline in the groundwater level from the 1940's up to the 1970's then is gradual up to the present, as seen in Figure 6.53c.

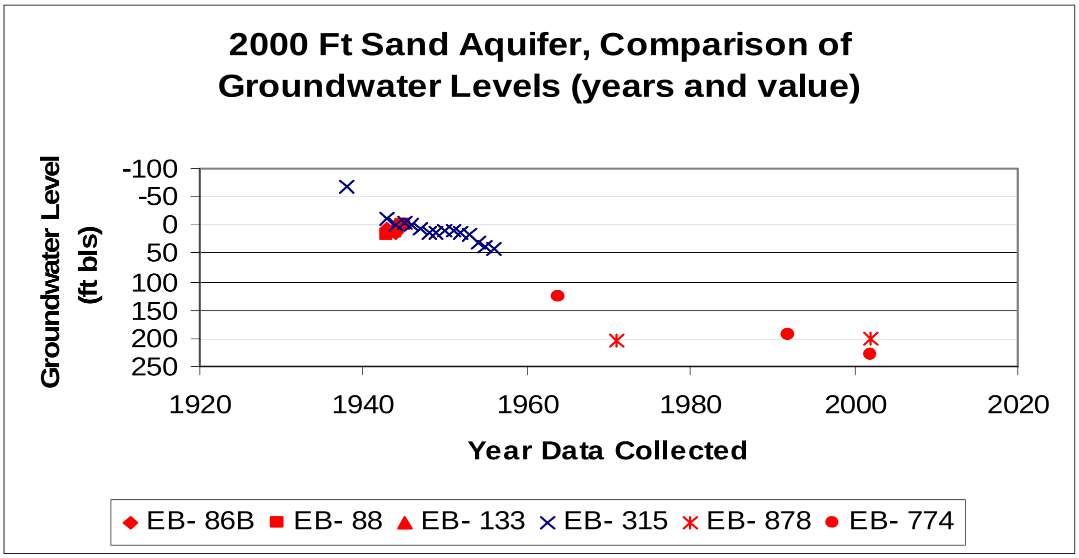


Figure 6.53c. This hydrograph not only compares different wells but also the years of different elevation data for each well within the 2000 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Scotlandville fault are shown in red.

There are two wells screened in the 2400 ft Sand aquifer in the area of both the school and fault, as seen in Figure 6.53. USGS Well EB- 514B is the closest 2400 ft well at an approximate distance of 13,125 ft from both the school and fault. EB- 154 is the furthest 2400 ft Sand well at an approximate distance of 15,750 ft from the school to the southeast, and approximately 10,500 ft directly south of the fault.

When comparing the different years of data for EB- 514B, it must be noted that the values are averaged because of multiple measurements taken within each year. Groundwater level values decline from 1954 to 1955. There has been a gradual decline of water levels up till the mid 1950’s then a drastic decline up to the mid 1970’s then is gradual up to the present, as seen in Figure 6.53d.

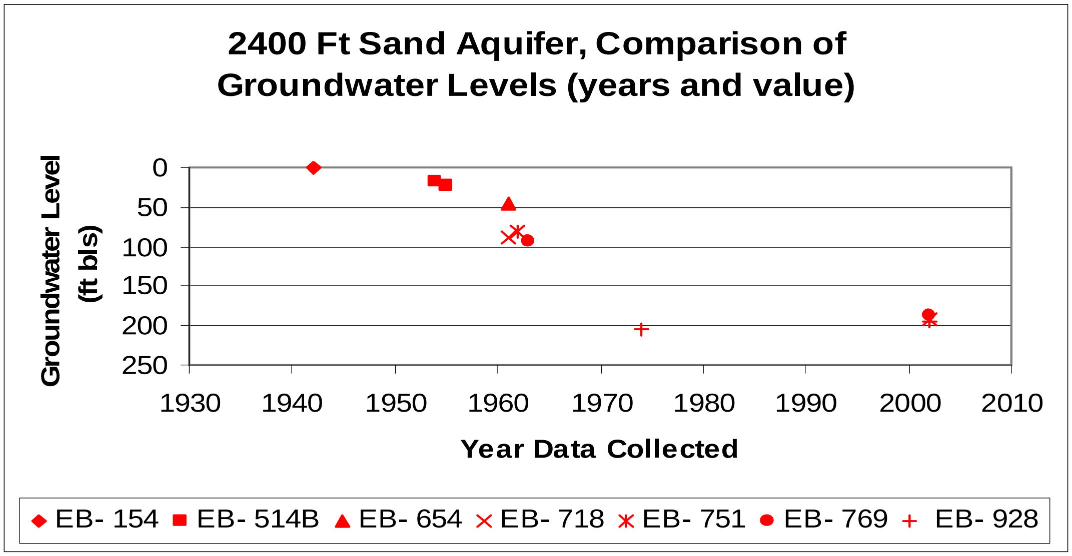


Figure 6.53d. This hydrograph not only compares different wells but also the years of different elevation data for each well within the 2400 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Scotlandville fault are shown in red.

There are two wells that are screened in the 2800 ft Sand aquifer in the area of both the school and fault, as seen in Figure 6.53. USGS Well EB- 700 is the closest 2800 ft well at an approximate distance of 5250 ft from both the school and fault to the north. EB- 378 is the furthest 2800 ft Sand well at an approximate distance of 10,500 ft from the school to the south, and approximately 5250 ft directly south of the fault.

When comparing the different years of data for EB- 700, groundwater level values decline from 1970 to 1990. When comparing the different years of data for EB- 378, negative values (artesian setting) get smaller in 1953 to a minimum value in 1972 (groundwater levels declining). There has been a gradual decline of water levels from the 1950’s on up to the present, as seen in Figure 6.53d. Figure 6.53e shows a plot of the 2800 ft Sand wells both in close proximity as well as in the general area of the field study area shown in Figure 6.53 with their years of data versus the groundwater level measurements.

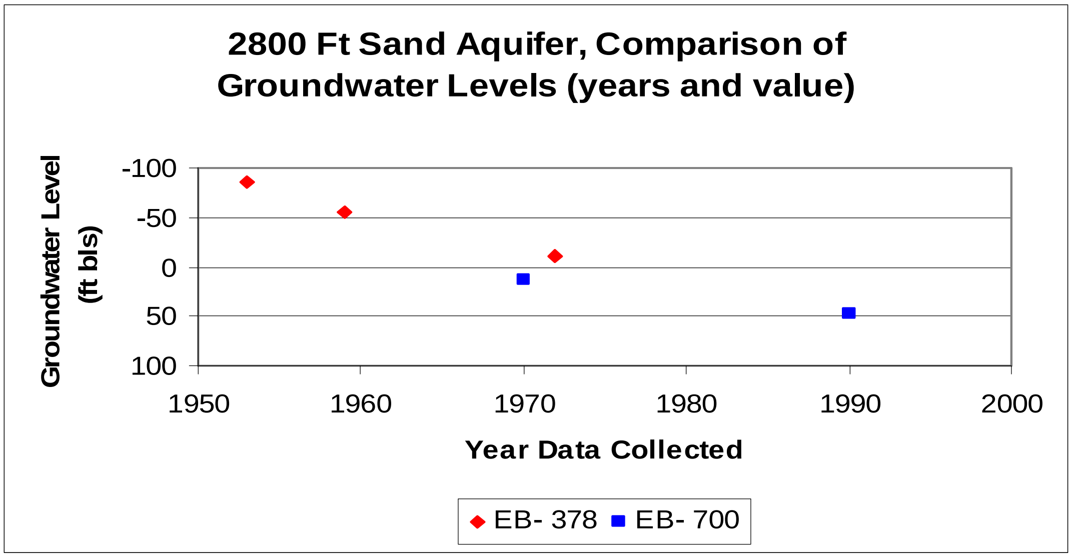


Figure 6.53e. Comparing of multiple wells and their corresponding multiple years of groundwater level data for the 2800 Ft Sand Aquifer. Wells that are located north of the fault are shown in blue; those wells located south of the Scotlandville fault are shown in red.

CHAPTER 7

DISCUSSION

7.1 GPR in the Field Study Areas

GPR has been used to image shallow faults throughout the globe; such as normal faults in Spain and Italy (Reiss et al., 2003) and active faults in the Roer Graben in Belgium (Dermanet, et al., 2000). GPR allows for the imaging of these faults from ground surface to shallow depths. In looking at the faults, geology and GPR used for these areas vs. what I have used in my study there are some fundamental differences:

- In the Reiss et al., paper they used 200MHz and 400 MHz antennas, their faulted soils were alluvial and colluvial therefore a bare minimum of data processing after data acquisition was required. They used a gridding system to acquire their data which enabled 3-D modeling later on in the project. They had access to trenching work in the area to check their GPR interpretations. However, the GPR features observed that enabled them to see their faults included reflector bundles being interrupted and displaced (offset is how I describe it), and juxtapose strata with varying dips (the V shape or bowl shaped feature observed in my study);
- In the Dermanent et al., paper they used GPR in conjunction with other geophysical tools to image faults, the GPR specifically was used to image the faults more precisely, they also used trenching to help check their geophysical interpretations, they used both 120MHz and 50MHz antennas for their GPR acquisition, they did have some clays in their study area.

7.1.1 Former Woodlawn High School

The evaluation of transect data for the former Woodlawn High School will start with the red area which includes the closest transect to the western wall of the Band Room working westward, then to the blue area which includes the Band Room transects working eastward to the green area which includes the furthest east WAYWALK transects, and then to the yellow area which includes the closest transect to the southern wall of the Band Room working southward. When looking at the western transects, there is one main large bowl shaped feature that I am trying to trace throughout these shallow transects, there are also several internal offsets within this bowl shaped feature, 5 of which can be traced throughout the transects in the area. An additional six offsets are not present in all of the transects. These two main structural features, the bowl and offsets of bedding, most likely correspond to one or both of the cracks observed in the western wall of the Band Room. Figure 7.1 is a diagram that traces both the bowl shaped graben feature and internal fault structures throughout the transects along the western side of the Band Room. The X axis shows horizontal distance covered and the Y axis shows closeness to the western Band Room building.

According to Davis and Reynolds, 1996, a graben is where the soil beds are downward dropped, and there are relatively unrotated blocks bounding on either side by inward-dipping normal faults. According to Reiss, et al., 2003, growth faults tend to be displayed as either half grabens or grabens and their dips are steeper at shallower depths. When comparing the shorter transects such as WOOD1_4/1_8, WOOD2_8 and WOOD3_8, they each appear to show the deeper more concave downward portion of the graben structure. The longer transects such as WOOD2_L1, WOODNEW, WOODNEW2, WD2_L2F and WD2_L3F show the same deep concave downward portion of the graben structure at the beginning of section. However, the bowl shaped structure appears to get shallower and pinch out towards the south (Figure 7.1).

There are several groups of offsets or internal faults within the graben structure that appears to exist in all transects. The offsets or faults have been color coded so that they can be traced throughout the transects. The light pink fault is observed at the northernmost portion of the transects and is seen from the first transect, WOOD1_4 throughout the transects up to WD2_L2F; however, does not include the very last transect WD2_L3F going westward. The purple, blue, green, purple pink and yellow faults are observed throughout the transects from the first to last transect moving westward. The orange, blue, olive and cream faults are observed throughout the longer transects which includes WOOD2_L1, WOODNEW, WOODNEW2, WD2_L2F and WD2_L3F. The orange fault is also observed in one shorter transect, WOOD2_8. Additionally, there is also the brown fault which is only observed in two of the longest transects, WOOD2_L1 and WOODNEW and is the furthest southern offset/fault observed along the transects in this section.

The eastern transects which includes both the blue and green areas, also show one main large bowl shaped feature. There are also six internal offsets, which may be faults within this bowl shaped feature. The internal offsets show varying degrees of dip. For WOOD1_4, WOOD1_8 and WOOD3_8 the average angle of dip for each of the offsets/faults is 22.5^{o} North. For WOOD2_8 the average angle of dip for the faults is 11.25^{o} North. For WOODNEW, WOODNEW2, WD2_L2F and WD2_L3F the average angle for the faults from pink to purple pink is 45^{o} North, and from yellow to the end of the transect is 45^{o} South. Also, for WOOD2_L1 the average angle of dip for the faults from pink to purple pink is 45^{o} North, and from yellow to brown is 11.25^{o} to 22.5^{o} South. Figure 7.2 is a diagram that traces both the bowl shaped graben feature and internal fault structures throughout the transects going west through the Band Room and walkways between the buildings.

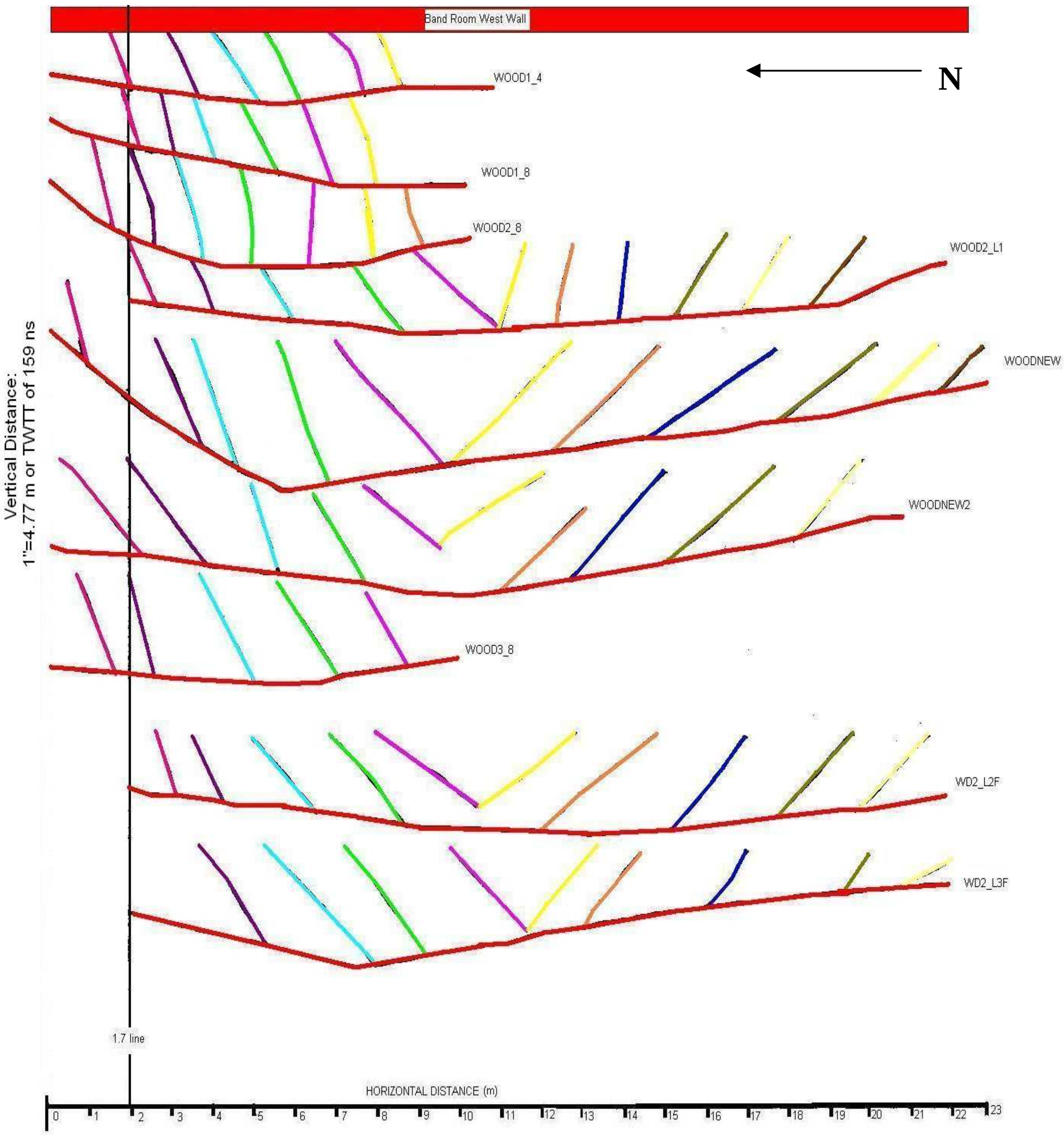


Figure 7.1. The curved lines in this diagram are traces of the bowl shaped feature, the colorful lines trace similar faults/offsets throughout these transects that are in the red area in Figure 6.10.

The two main structural features, the bowl and offsets of bedding, again most likely correspond to one or both of the cracks observed in the western wall of the Band Room. The amount of offset/displacement measured in the subsurface from the GPR transects is approximately 4-6 inches and is about two times larger than the offset measured in the above ground structures which is between 2-3 inches. The shorter the (BAND1, BAND2, WAYWALK1 and WAYWALK2) transects, the more each appear to show the deeper more concave downward portion of the graben structure like the shorter transects previously from the red area.

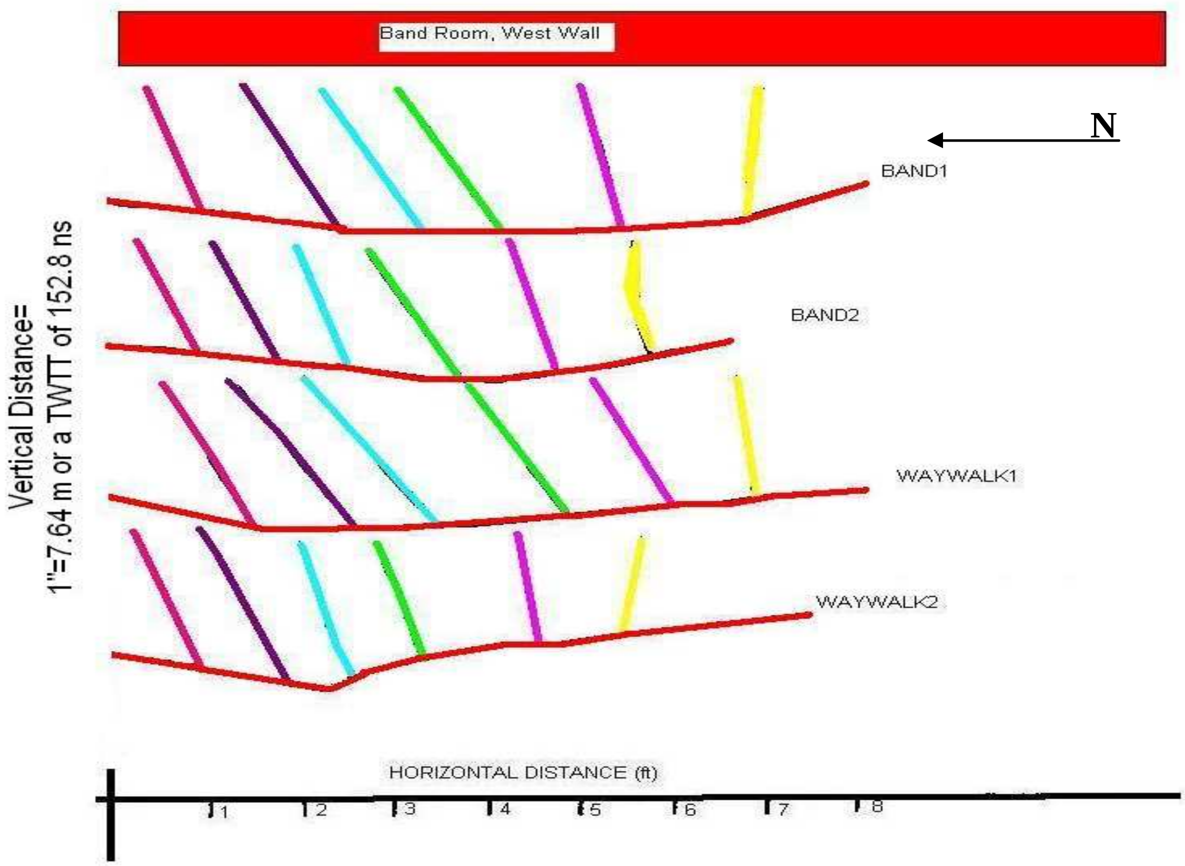


Figure 7.2. The curved lines in this diagram are traces of the bowl shaped feature, the colorful lines trace similar faults/offsets throughout these transects that are in the blue and green areas in Figure 6.10.

There is a group of six offsets or internal faults within the graben like bowl structure that appear to exist throughout the transects. The offsets or faults have been color coded so that they can be traced throughout the transects. These faults are outlined in light pink, purple, blue, green, purple pink and yellow and are observed in each transect in both the blue and green areas (Figure 7.2). These same faults were also observed in the red area previously discussed. The internal offsets/faults show varying degrees of dip. For BAND1, BAND2 and WAYWALK1 the average angle of dip for each of the pink to purple faults is 22.5^{o} North. For BAND1, BAND2 and WAYWALK2 the angle of dip for the yellow fault is approximately 5.6 ^{o} North. Also, for WAYWALK2 the average angle of dip for the pink to purple pink faults is 11.25 ^{o} North, and for the yellow fault is 11.25 ^{o} South.

The southern transects starting adjacent to the Band Room southern wall and working southward towards the bordering road (yellow area in Figure 6.10), there is a main cross over feature throughout these shallow transects, there are also several internal offsets within the cross over shaped feature, 5 offsets can be traced throughout the transects except one transect that is too short to show them all and an additional two to six that are not present in all of the transects. The cross over and offsets of bedding cannot be directly correlated to surface structural damage because none was observed on this side of the building. Figure 7.3 is a diagram that traces this cross over shaped feature throughout the transects going southward away from the Band Room building.

When comparing the two transects furthest north in this area the cross over is towards the west, WOOD2_T3 and WD2_T6, and as move southward the remaining transects show the cross over more towards the eastern side of the transect. Five offsets are more or less present throughout and two additional offsets that are only present in a couple of transects. The offsets or faults have been color coded so that they can be traced throughout the transects. The group of five faults that is present throughout all the transects, except for WD2_T13R because it is too short, are outlined in yellow, pink, blue, green and purple. Additionally in transects WD2_T6F and WD2_T13F and WD2_T13R, reverse transect of WD2_T13F but only the furthest eastern portion, there are two more faults present and are outlined in orange and cream. The internal offsets/faults show varying degrees of dip. For all transects included in Figure 7.3 the average angle of dip for each faults is 45° East. Figure 7.3 is a diagram that traces both the cross over shaped feature and internal fault structures throughout the transects going south away from the Band Room.

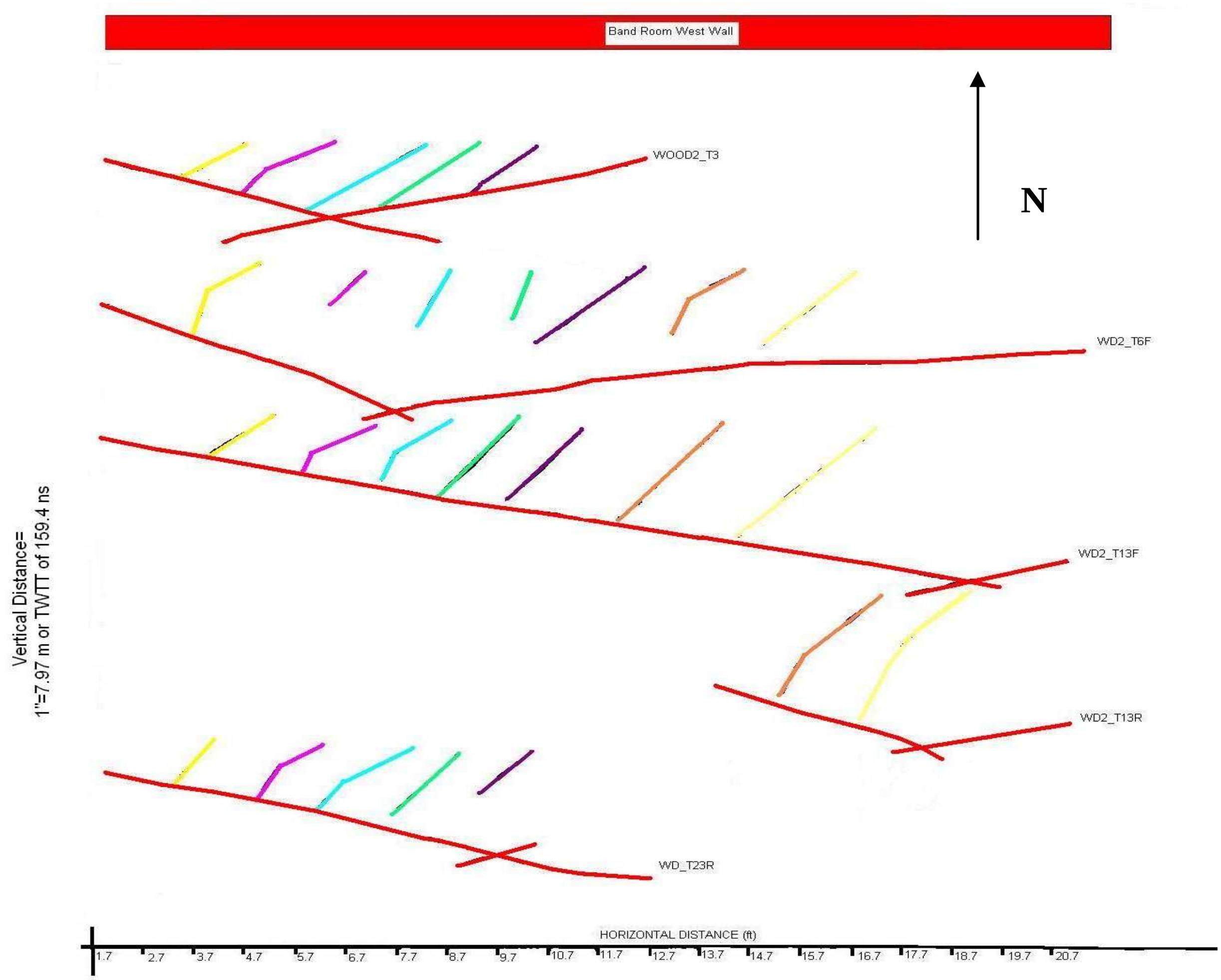


Figure 7.3. The X shaped lines in this diagram are traces of the cross over feature, the colorful lines trace similar faults/offsets through these transects that are in the yellow area in Figure 6.10.

7.1.2 Glen Oaks High School

The evaluation of transect data for the Glen Oaks High School starts with the furthest transect to the east of the former Building H, (red area), then proceeds west to the furthest transect to the west of the former Building H (blue area) (Figure 6.40). There is one main V shaped feature and three offsets which can be traced throughout the transects in the red area. The V feature and offsets of bedding most likely correspond to the former Building H structural damage. Figure 7.4 is a diagram that traces both the V shape and the additional offsets in bedding. The X axis shows horizontal distance covered and the Y axis shows closeness to the former Building H.

When comparing the transects individually, the graben feature is observed at the southern end of each of the transects along the inside covered walkway, WLKWY1-3, and are outlined in blue and green in Figure 7.4. Three additional offsets are present throughout these transects. The internal offsets/faults show minimal variation in degree of dip. For WLKWY1 and WLKWY2 the average angle of dip for each of the yellow to blue faults is 22.5^{o} North, and for the green fault is 22.5^{o} South. Also, for WLKWY3 the average angle of dip for each of the yellow to blue faults is 11.5^{o} North, and for the green fault is 22.5^{o} South. The offsets or faults have been color coded (yellow, purple and pink) so that they can be traced throughout the transects (Figure 7.4).

The western transects (blue area in Figure 6.40), west of the former Building H, have several offsets in bedding observed in both transects. The graben feature observed in Figure 7.4 is not present in these transects. However, the same offsets are present. The graben feature in Figure 7.4 is outlined in blue. In Figure 7.5 the same northern offset is outlined in blue; however, the corresponding limb to complete the graben structure is not present.

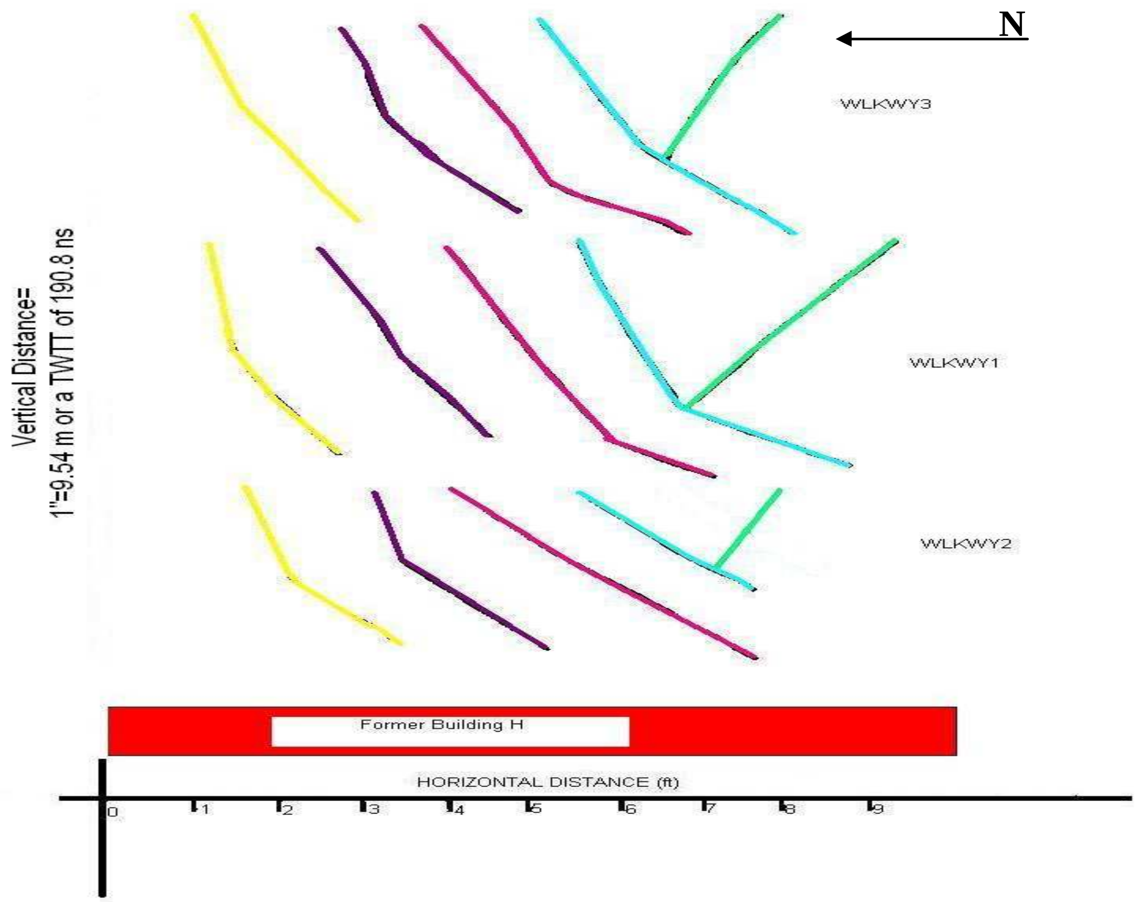


Figure 7.4. The V shaped feature in this diagram is tracing the graben shaped feature, the colorful lines trace similar faults/offsets through these transects that are in the red area in Figure 6.40.

Four offsets in bedding are present throughout these transects. The internal offsets/faults show no variation in degree of dip. For OSWLKWY1 and DVWY1 the average angle of dip for all faults is 45^{o} West of North. The offsets or faults have been color coded (yellow, purple, pink and blue) so that they can be traced throughout the transects. Figure 7.5 is a diagram that traces the offsets in bedding. The X axis shows horizontal distance covered and the Y axis shows closeness to the former Building H.

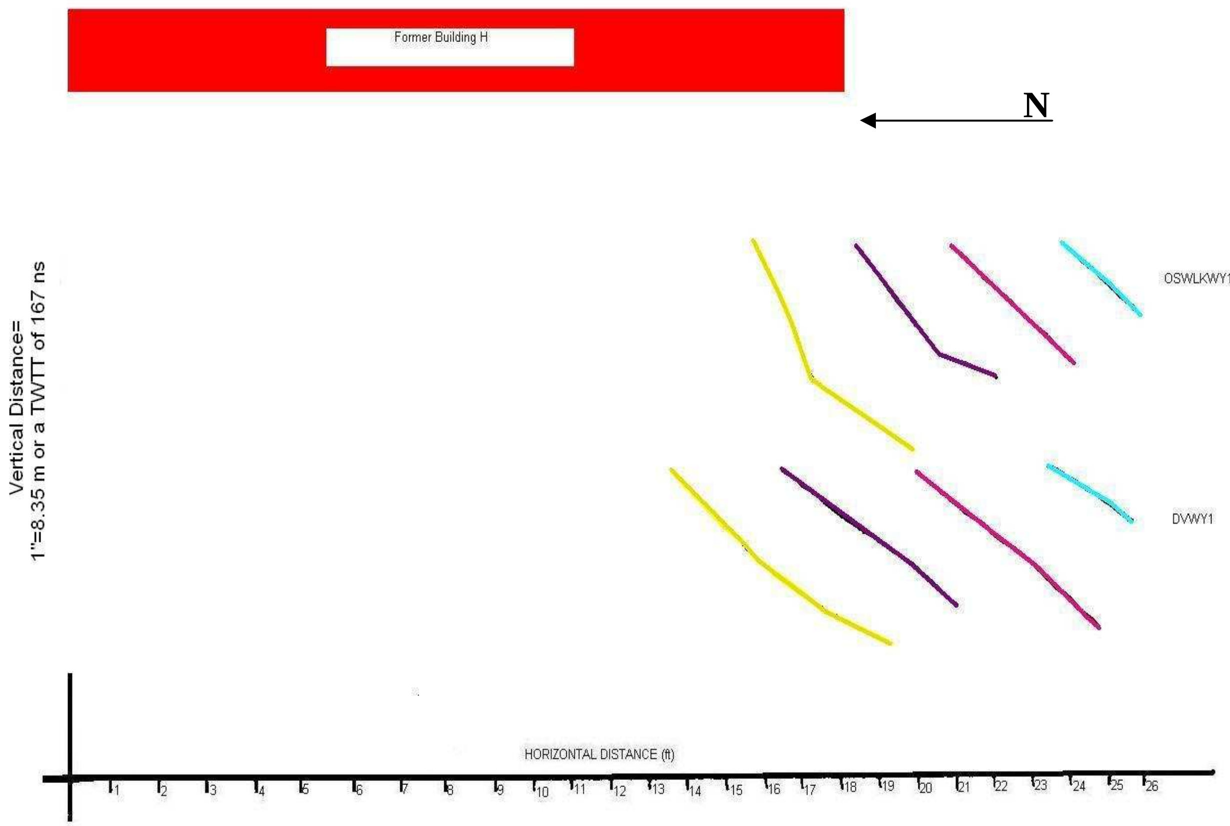


Figure 7.5. The colorful lines trace similar faults/offsets through these transects that are in the blue area in Figure 6.40.

In both field study areas there is a graben or half-graben feature. According to McCulloh, 2001, the structural damage in these areas can be contributed to movement along either the Scotlandville or Baton Rouge Faults. When comparing the structural offset damage vs. the GPR imaged geologic offsets in the subsurface, to the path of the fault that can be depicted from the LIDAR data, these are all ways of imaging the results of fault movement. Specific limitations in regards to the data processing programs are covered in the next section.

7.1.3 Data Limitations

Limitations and corresponding recommendations in the GPR portion of this study are as follows:

- A limitation was the use of a small power source, 400V, for future work the use of the 1000v power source would be beneficial;
- A limitation was the use of mostly just the 100MHz antennas, for future work the use of the 50MHz antennas would be beneficial and may help to image the faults deeper to determine specifically what kind they are, simple normal fault, or normal growth fault;
- Would use the Constant Gain feature available during data acquisition more sparingly because in most cases when collecting through concrete/asphalt there was too much amplitude in the data. It was not possible to process it out;
- Due to the data acquisition set up, it was very difficult to determine actual soils velocities, in retrospect a 3D grid and expanding spread data acquisition set up or some strategically placed trenches may help get better data;
- Also, maybe some soil borings at discrete points along the gridding system, this would enable a better determination of the exact soils imaging in the subsurface, their depths, and would help determine a more accurate soil velocity for determining depth of reflectors and 2-D migration during for GPR transects data processing;

7.2 LIDAR, Geodetic Leveling, Hydrogeology in Field Study Areas

Next a comparison is made between the LIDAR, Geodetic Leveling and Hydrogeology data to what is observed in the GPR transects and in the structural damage at ground surface. Unfortunately, only one year of LIDAR data exists that covers the whole of Louisiana; therefore, no comparisons can be made between multiple years. However, I can use the LIDAR data since it was collected in 1999 to try and compare to the Geodetic Leveling and Hydrogeology data that have multiple years of data. When comparing the Hydrogeology years of data for the main aquifers vs. the Geodetic Leveling and LIDAR years of data near each of the field study areas, there appear to be too many data gaps.

An overall evaluation was made of the main aquifers and their groundwater elevation levels in the two field study areas. The trend in groundwater levels for the area around the former Woodlawn High School is steadily declining with time, and appear to be declining at a fairly linear gradual slope. The trend in groundwater levels for the area around the Glen Oaks High School is also declining; however, it tends to have a high and low plateau with an intermittent sudden jump in depth to water levels. At the Glen Oaks High School site there are clearly artesian settings up till 1945, then from 1945 to the 1960's the water level drops drastically, and finally the elevations begin to level back out. The Glen Oaks High School is much closer to the industrial area, which would have been pumping on the aquifers at an increased rate from the time period of 1945 till 1960. Because of this, the jump in depth to groundwater in the area of the Glen Oaks High School is not that surprising. Also, due to a widely spread out cone of depression in the area, those wells near the former Woodlawn High School would not respond as drastically to an increase in the pumping rate. However, the aquifers in this area would respond but much later in time and at a much slower rate.

When comparing the former Woodlawn High School wells to the Glen Oaks High School in regards to groundwater elevations on the northern side of the fault versus southern side in their individual areas, the general trend for the groundwater levels varies. Near the former Woodlawn High School, for the most part in each main aquifer the levels are deeper on the northern side than the southern side of the Baton Rouge Fault; the exception is the 1500 ft Sand but only includes one well with one measurement. Near the Glen Oaks High School there is little to no difference in elevation between those on the northern side versus the southern side of the Scotlandville fault. In comparing the groundwater level data to NGS NMO data or to LIDAR, no direct comparisons can be made because the data is too sporadic.

Limitations and corresponding recommendations in the portion of this study that covers the NGS data, LIDAR data and USGS groundwater level data includes concentrating on geodetic releveling in the areas of concern during different seasons and sequential years. Also, to coordinate groundwater levels in the main aquifer USGS wells in the area in order to get a more accurate picture of groundwater affects on the fault activity/subsidence.

CHAPTER 8

CONCLUSIONS

Significant results of this study are:

(1) GPR transect data clearly shows that the Baton Rouge and Scotlandville faults are not just a single plane, but instead comprise a complex zone of parallel and antithetic offsets/faults that in some instances extend to a width of 20 m or greater. A diffuse fault zone has important hydrogeologic implications for fluid transport across the fault especially if this shallow response is observed at deeper depths. This suggests the need for future deeper imaging of these fault zones.

(2) Maximum depth of penetration from a TWTT of 322 ns to 467.8 ns, or 9.66 m to 35.085 m depending on soil lithology. GPR is able to trace both faults into the subsurface to a maximum TWTT of 160 ns to 180 ns, or depths of approximately 12 m to 13.5 m. Below these depths, signal attenuation and multiples makes interpretation of geologic features difficult. Thus, it was not possible to determine if the faults are growth faults that sole out at depth.

(3) The resolution of the GPR imaging was sufficient to estimate displacement along individual offsets of bedding planes. Displacements range between 4 to 6 inches.

(4) Fault dip angles for the former Woodlawn High School field study area vary significantly when comparing those transects orthogonal to the Baton Rouge fault trace versus parallel to the fault. The red zone GPR transects west of the Band Room and the blue and green zone GPR transects through the Band Room area, which are all orthogonal to the fault, had average angle dips for the faults/offsets from 11.25^{o} to 22.5^{o} regardless if they dip

north or south. The yellow zone GPR transects south of the Band Room, which are parallel to the fault trace, have average angle dips for the faults/offsets of 45^{o} to the west.

(5) The fault dip angles for the Glen Oaks High School do not vary much because all GPR transects were collected orthogonal to the Scotlandville fault trace. Both the red and blue zone GPR transects had average angle dips for the faults/offsets from 11.5^{o} to 22.5^{o} toward the north and antithetic faults/offsets dips of 22.5^{o} to the south.

(6) In most areas where transects were collected, either a concrete or asphalt cap was at the surface. However, no borings or trenches were done to determine what soils or sediments are at depth. Because both field study areas are in Louisiana, it was assumed that most soils or sediments at shallow depths were silts, clays, sands or a mixture.

(7) Possible mechanisms for fault movement may include bending stress, soil compaction, water withdrawal induced compaction, and slumping. GPR data are consistent with soil compaction and in particular compaction due to groundwater withdrawal as the primary mechanisms for fault movement.

(8) At the former Woodlawn High School site, the low spot in the graben observed in those transects in the red area (Figure 6.10) matches up with the crossover observed in the yellow area (Figure 6.10). Some of the offsets observed in both traces from the red and yellow areas are the same offsets just viewed from a different perspective. At the Glen Oaks High School site, no transects were perpendicular to each other, so geometric relations in three-dimensions can not be determined. Future work on these data should include a 3D model of subsurface transects, which include a grid system of data acquisition.

(9) LIDAR images show that for both faults the northern blocks are higher in elevation than the southern blocks, and that the elevations around the Scotlandville fault are higher than around the Baton Rouge Fault.

(10) Geodetic Leveling data spatially show in regards to the Scotlandville Fault that elevation values north of the fault are lower than south of the fault. Elevation data near the Baton Rouge fault do not vary significantly between the northern and southern sides.

(11) Geodetic Leveling data document that the entire region has subsided over the last 50 years.

(12) At both the former Woodlawn High School and Glen Oaks High School, laser level measurements show an offset of between 2 and 3 inches in building structures since 1960. Nunn (2003) demonstrated that groundwater withdrawals can produce 2-3 inches of subsidence in both of these areas over that time span. In contrast, the amount of offset observed in the GPR transects in the subsurface is approximately two times that measured with the laser level.

(13) The Hydrogeology groundwater elevation data shows spatially that elevations north of the fault are deeper than those south of the fault near the former Woodlawn High School. At Glen Oaks High School, groundwater elevations north of the fault are shallower than those south of the fault.

(14) Water level data show a temporal trend of steady decline around the former Woodlawn High School. Water levels appear to decline at a fairly linear gradual slope. Around Glen Oaks High School water levels also decline with time. However, the rate of water level decline was much faster in the 1950s and 1960s than either before or after this period. The pronounced groundwater decline around Glen Oaks High School is due to

the proximity of the industrial area, which pumped water from the aquifers at an increased rate from 1945 till 1960. Wells near the former Woodlawn High School also responded to the increased groundwater withdrawal in the industrial area but much later in time and at a slower rate because Woodlawn is much further away.

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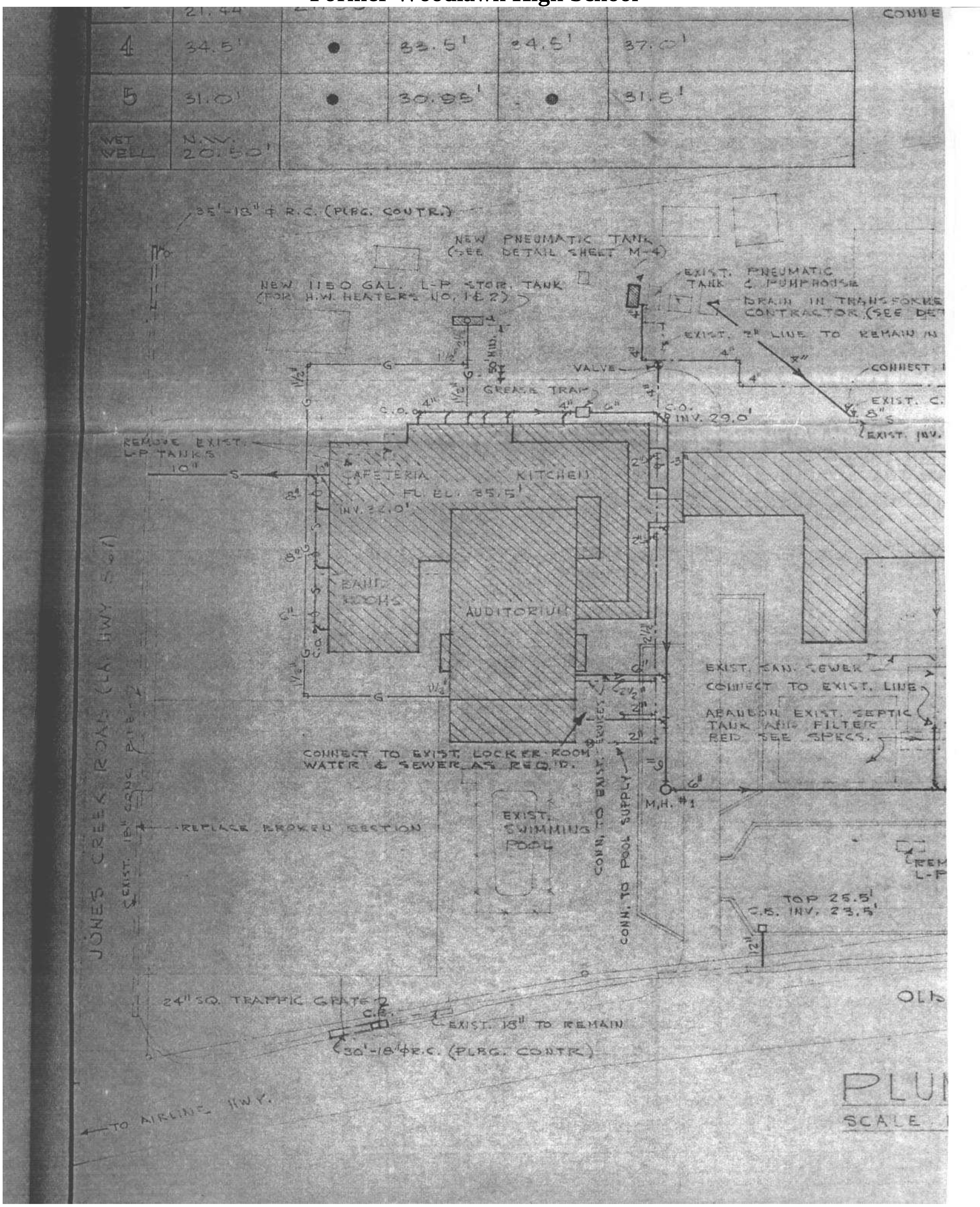
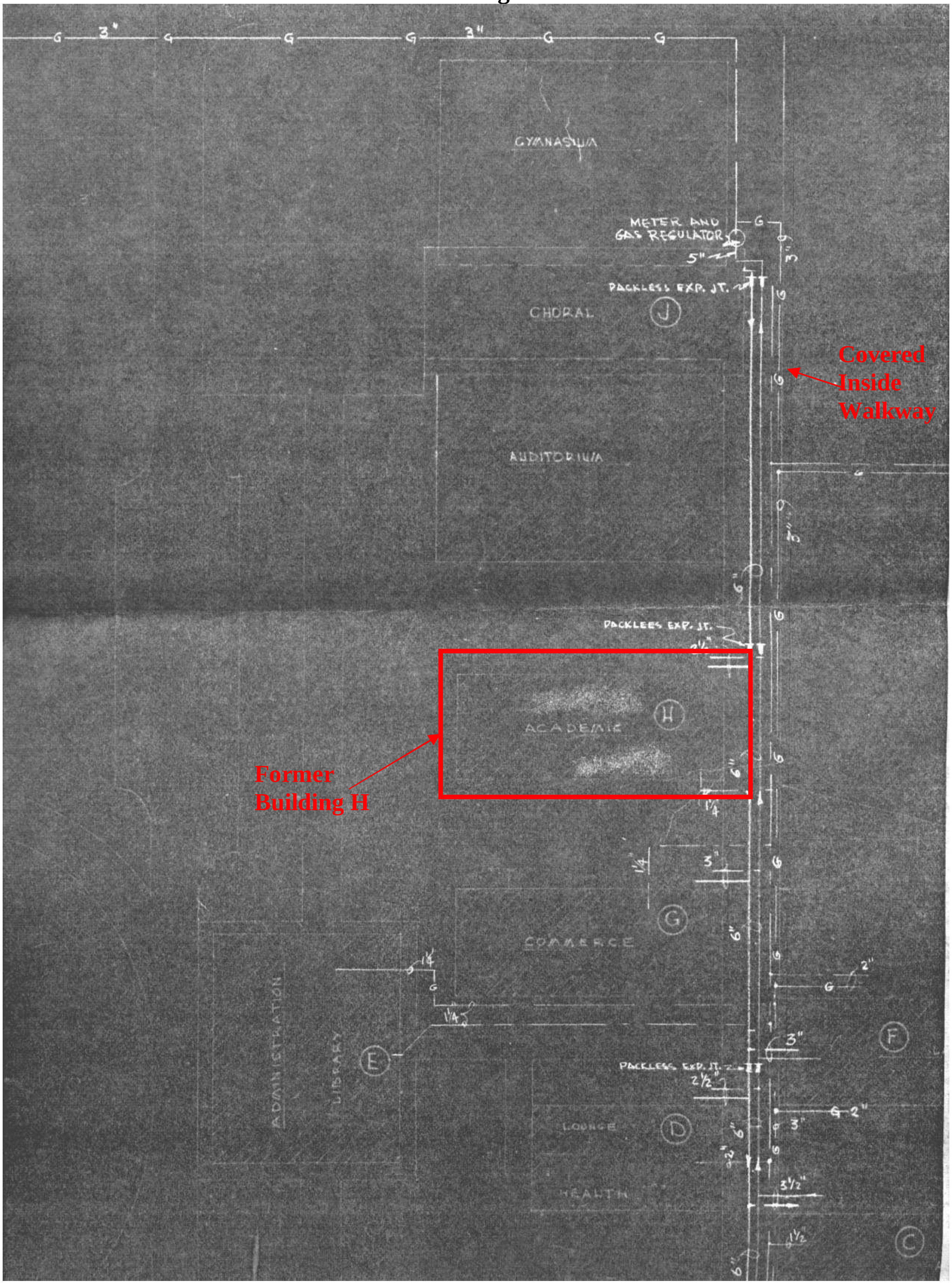
APPENDIX A. BLUEPRINTS OF SCHOOLS
Former Woodlawn High School

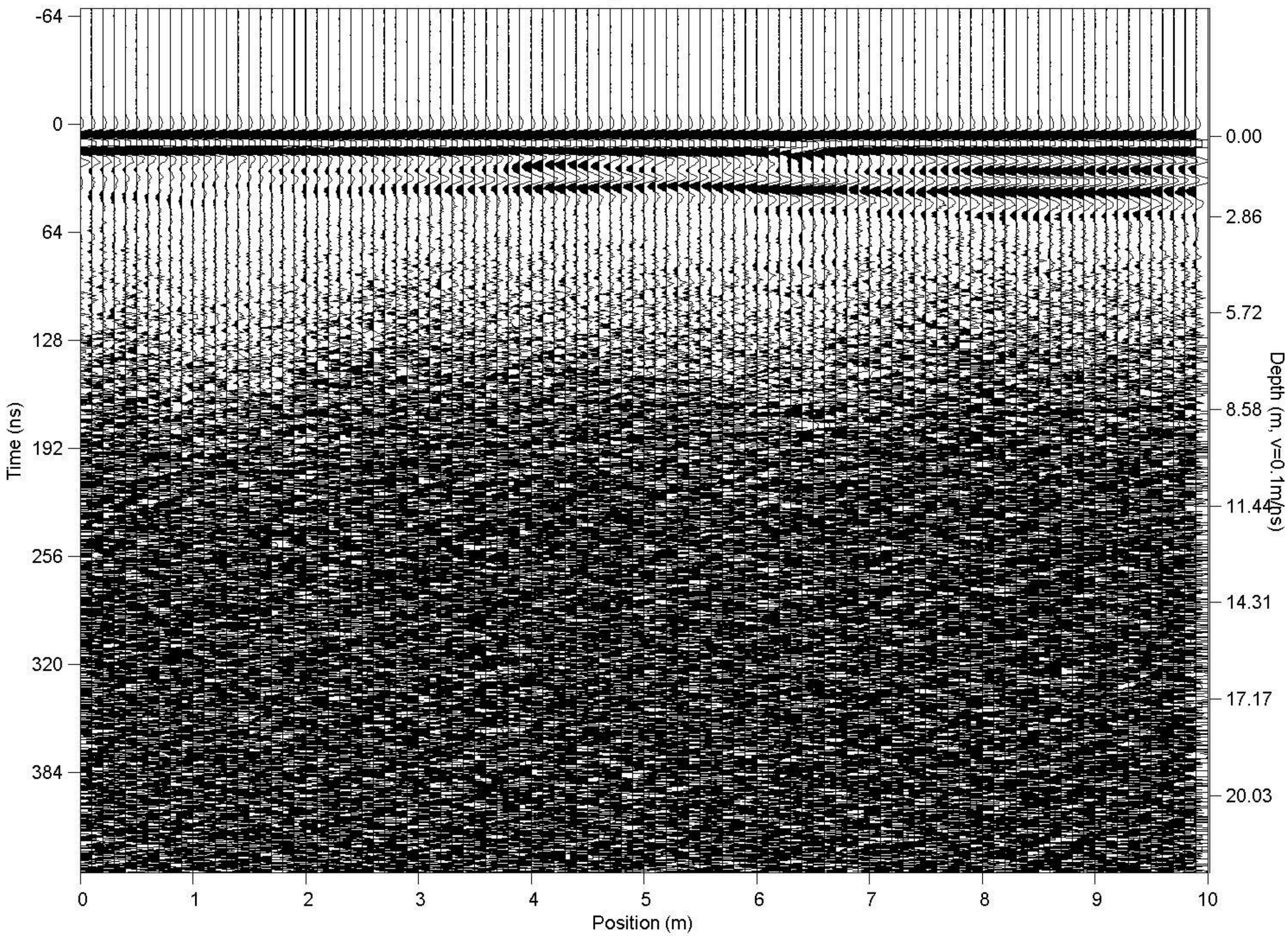


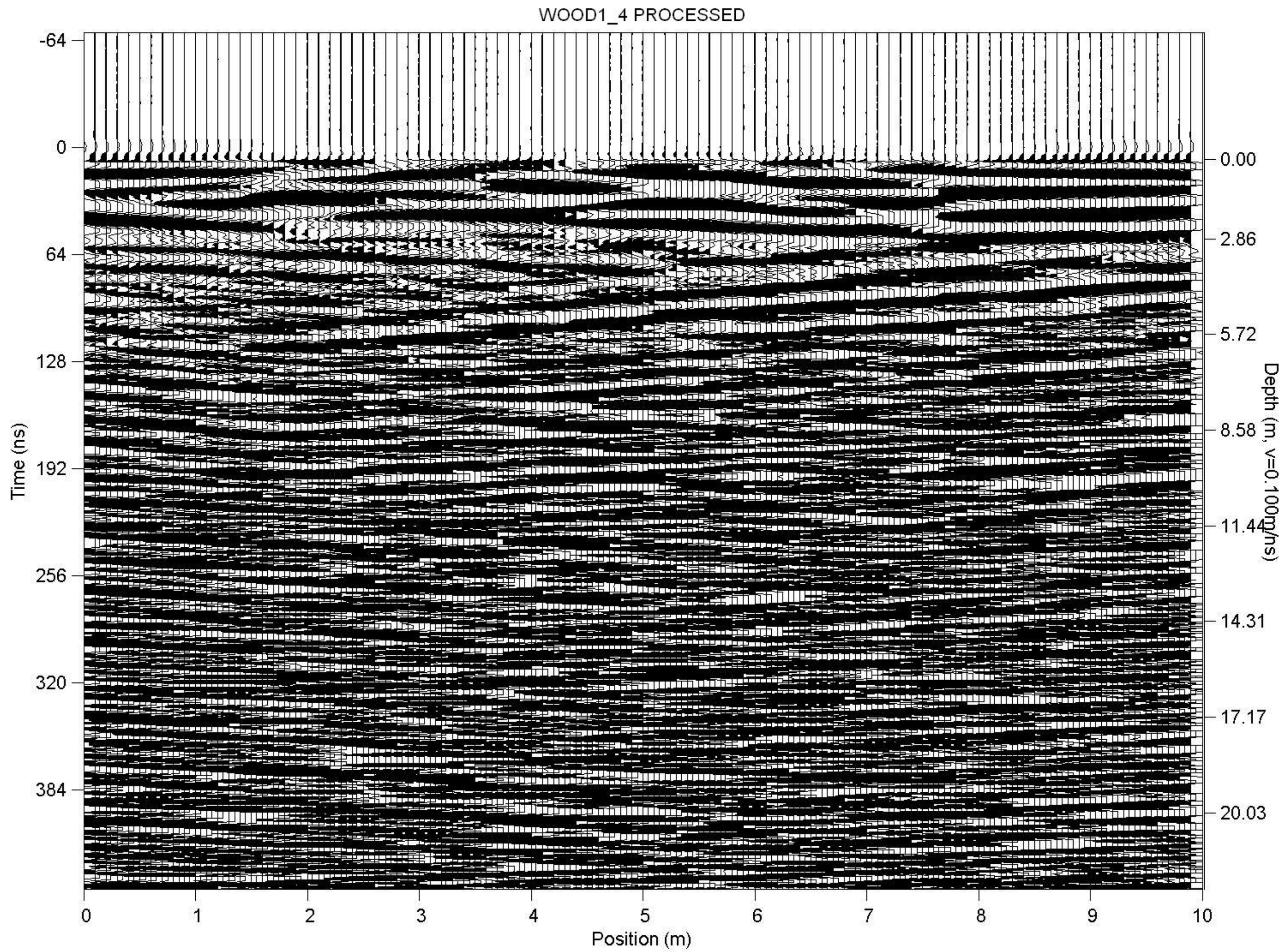
Glen Oaks High School



APPENDIX B. RAW AND PROCESSED GPR TRANSECTS

WOOD1_4 RAW

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64
128
192
256
320
384
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2.86
5.72
8.58
11.44
14.31
17.17
20.03
Position (m)
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2
3
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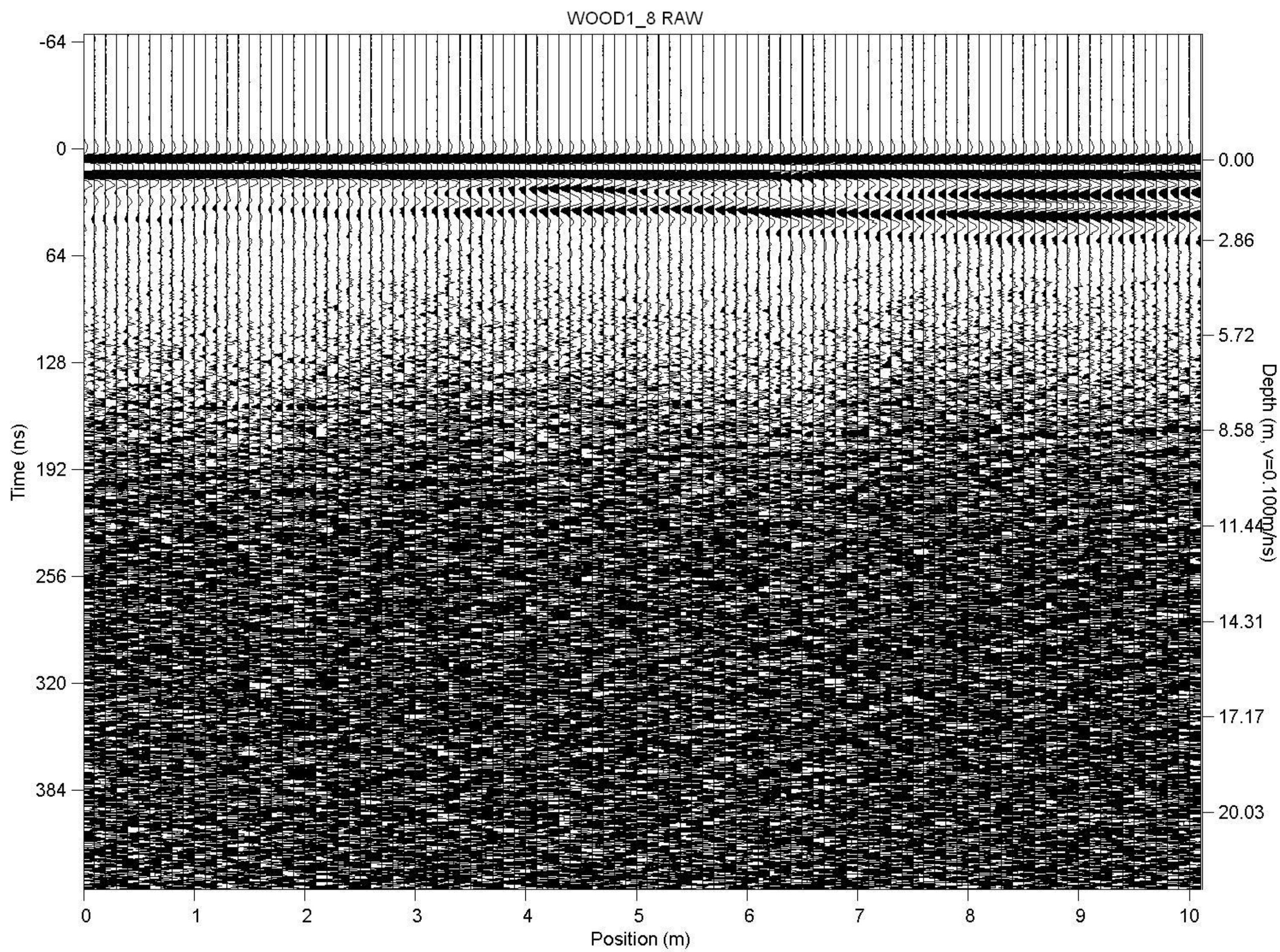
6
7
8
9
10



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5.72
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17.17
20.03
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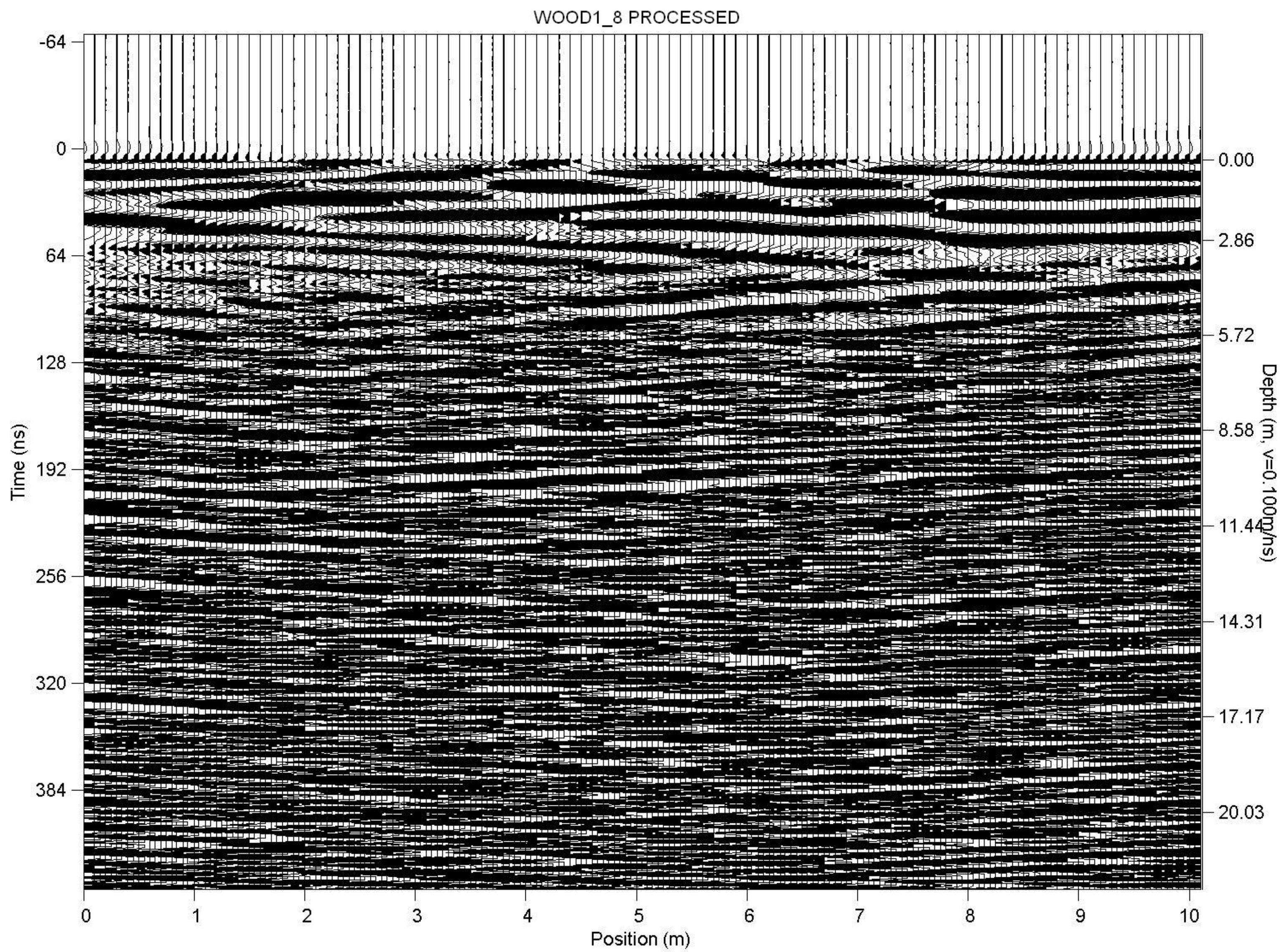
Position (m)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8.58
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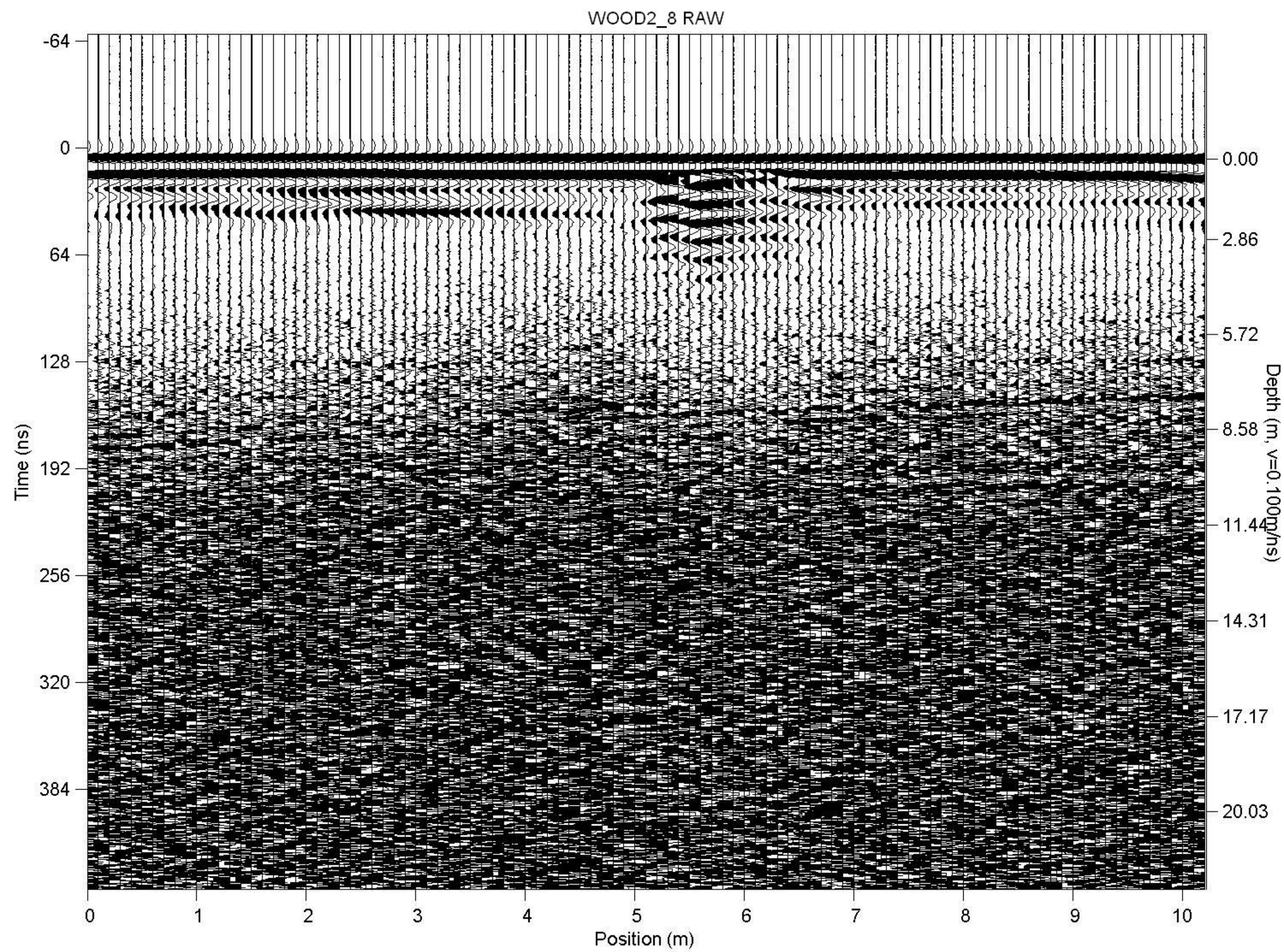
14.31
17.17
20.03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20.03
Position (m)
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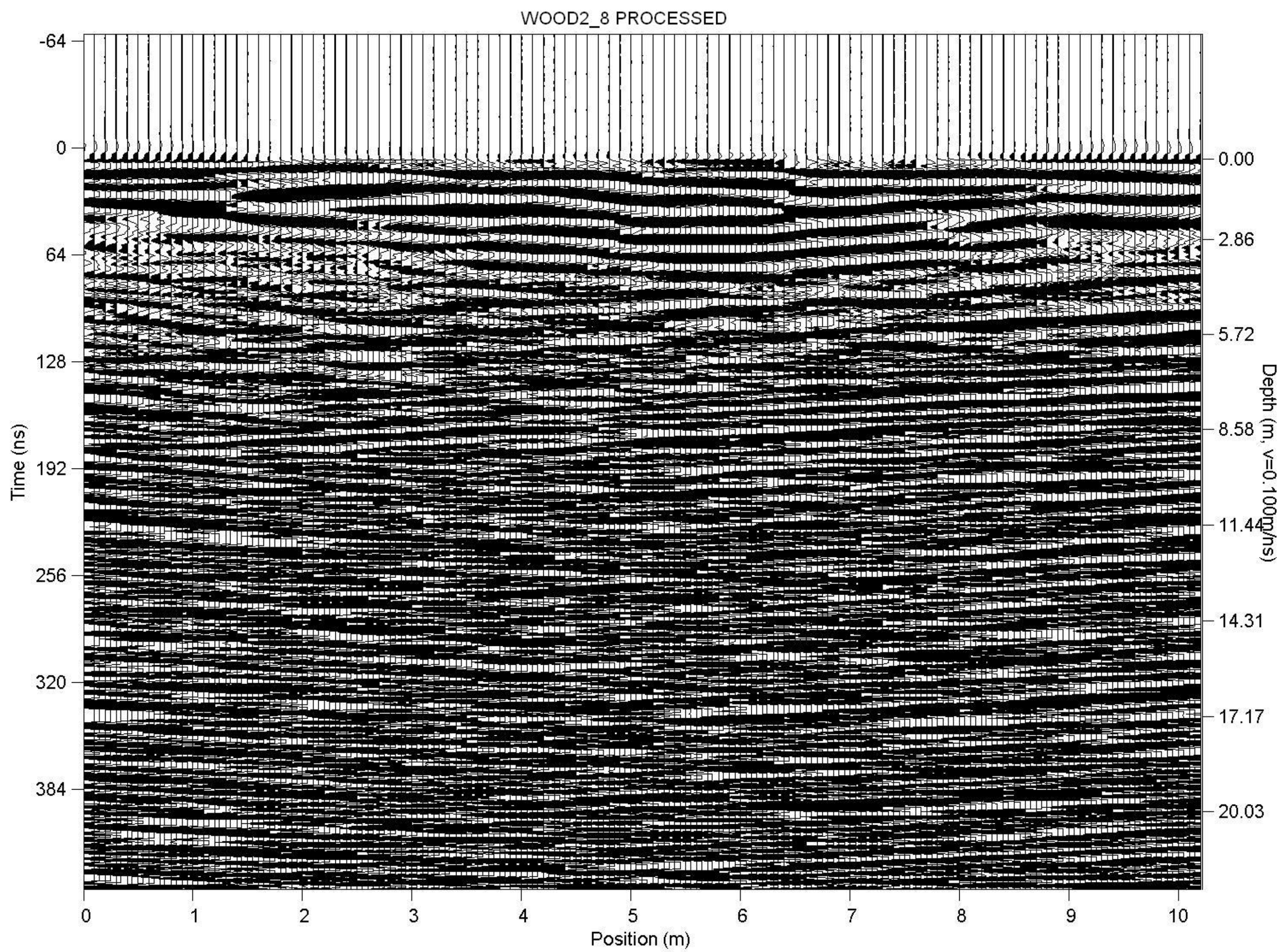
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Position (m)
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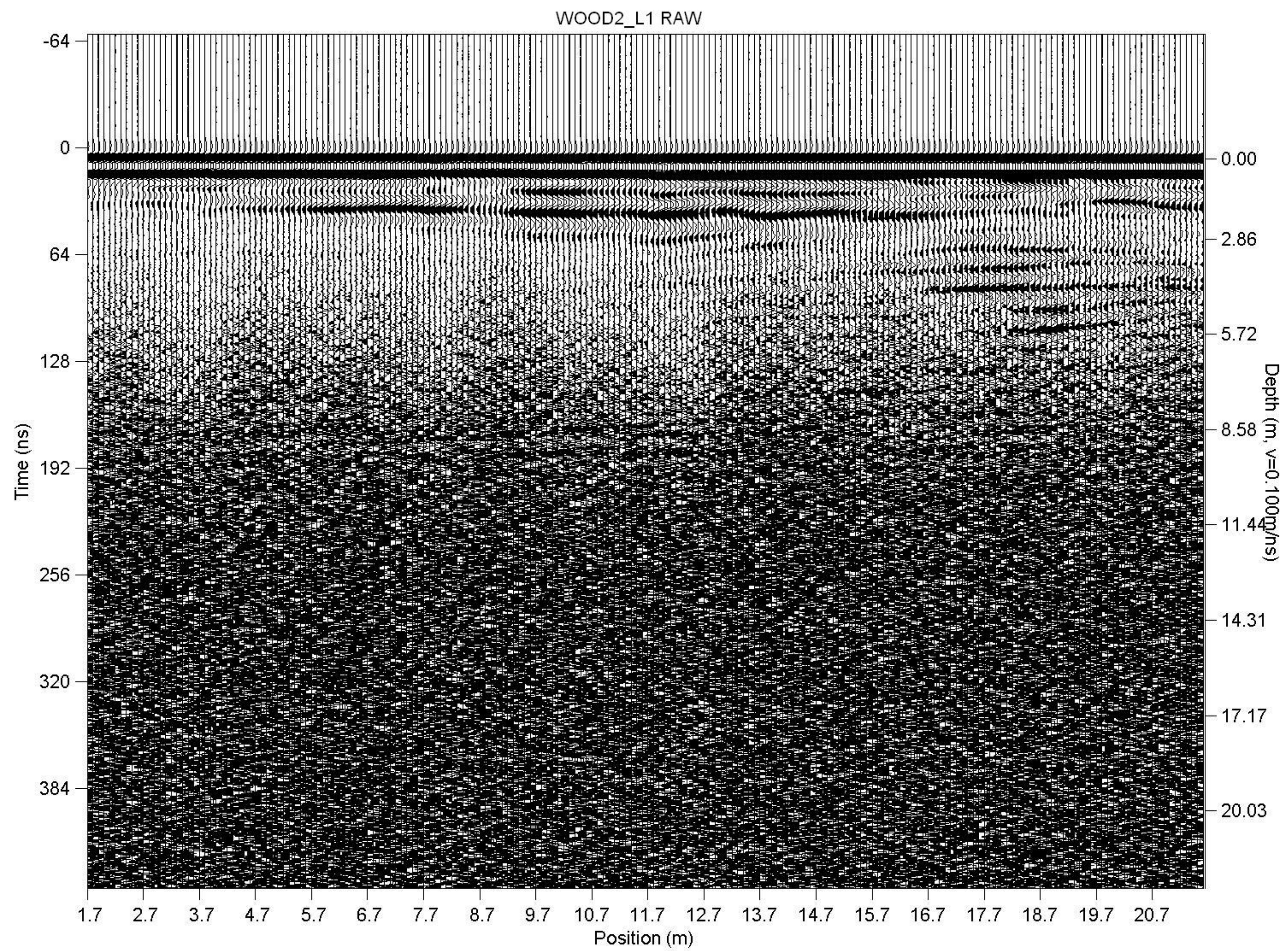
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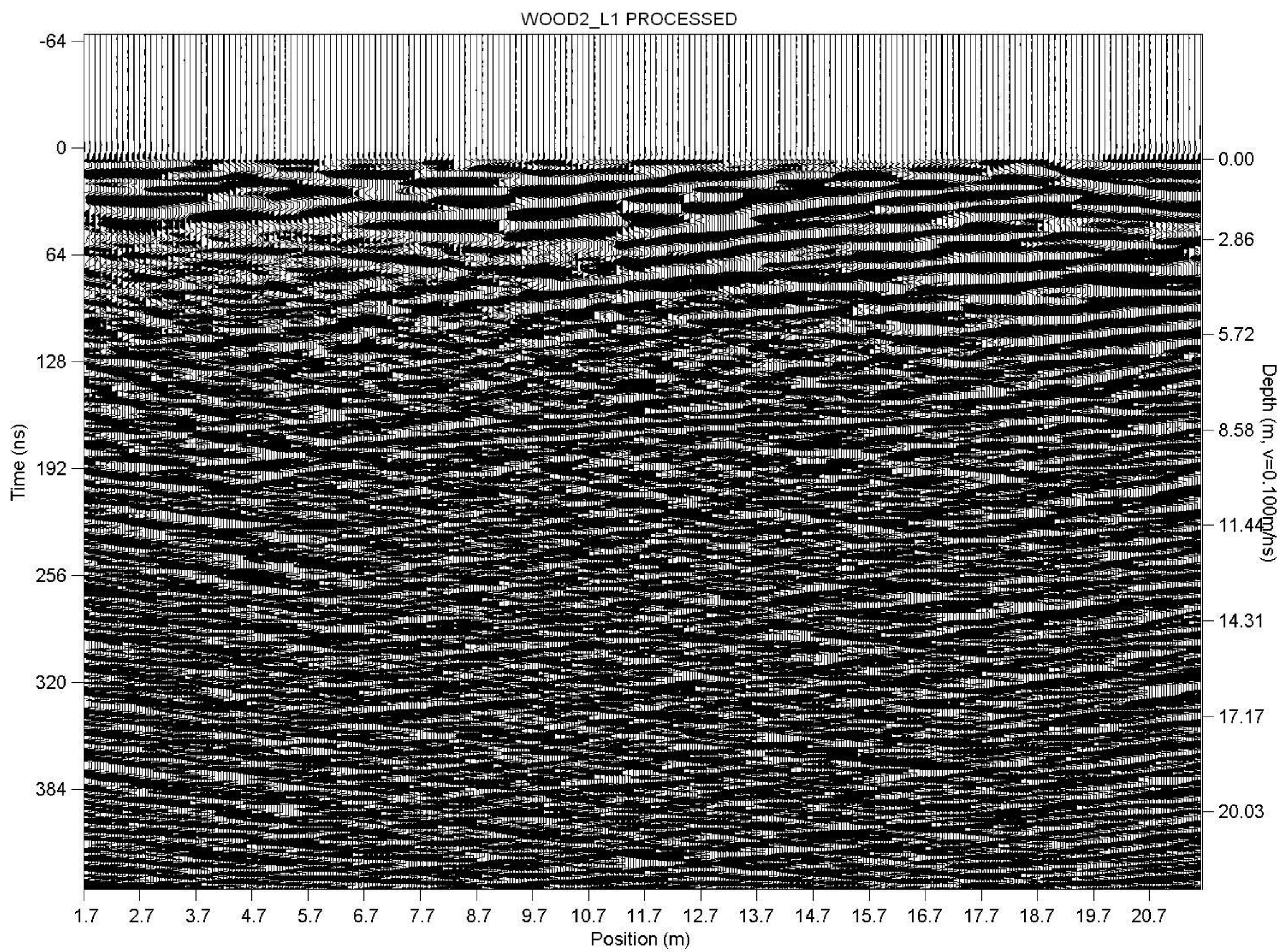
Position (m)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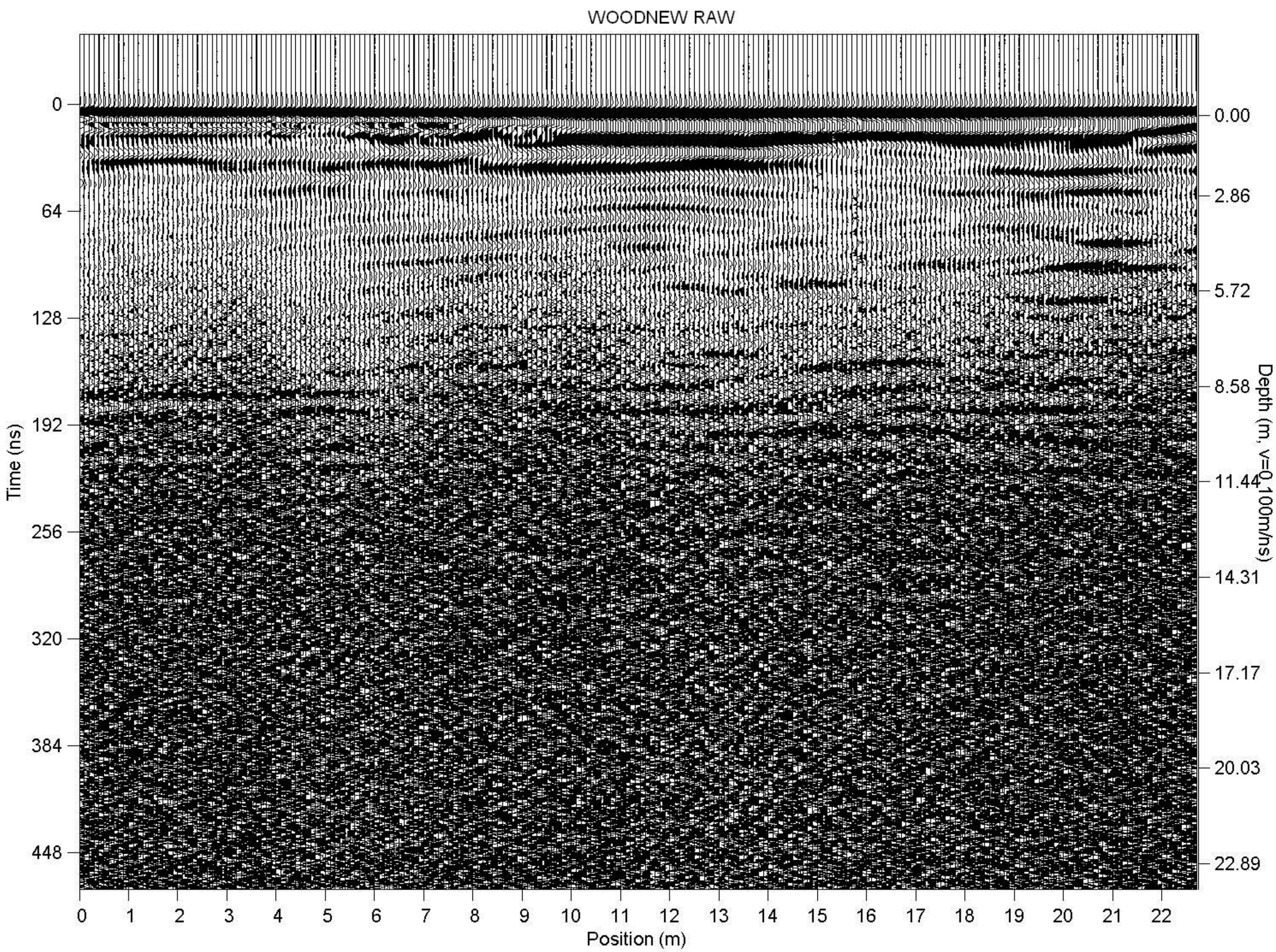
Position (m)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5.72
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14.31
17.17
20.03
22.89
Position (m)
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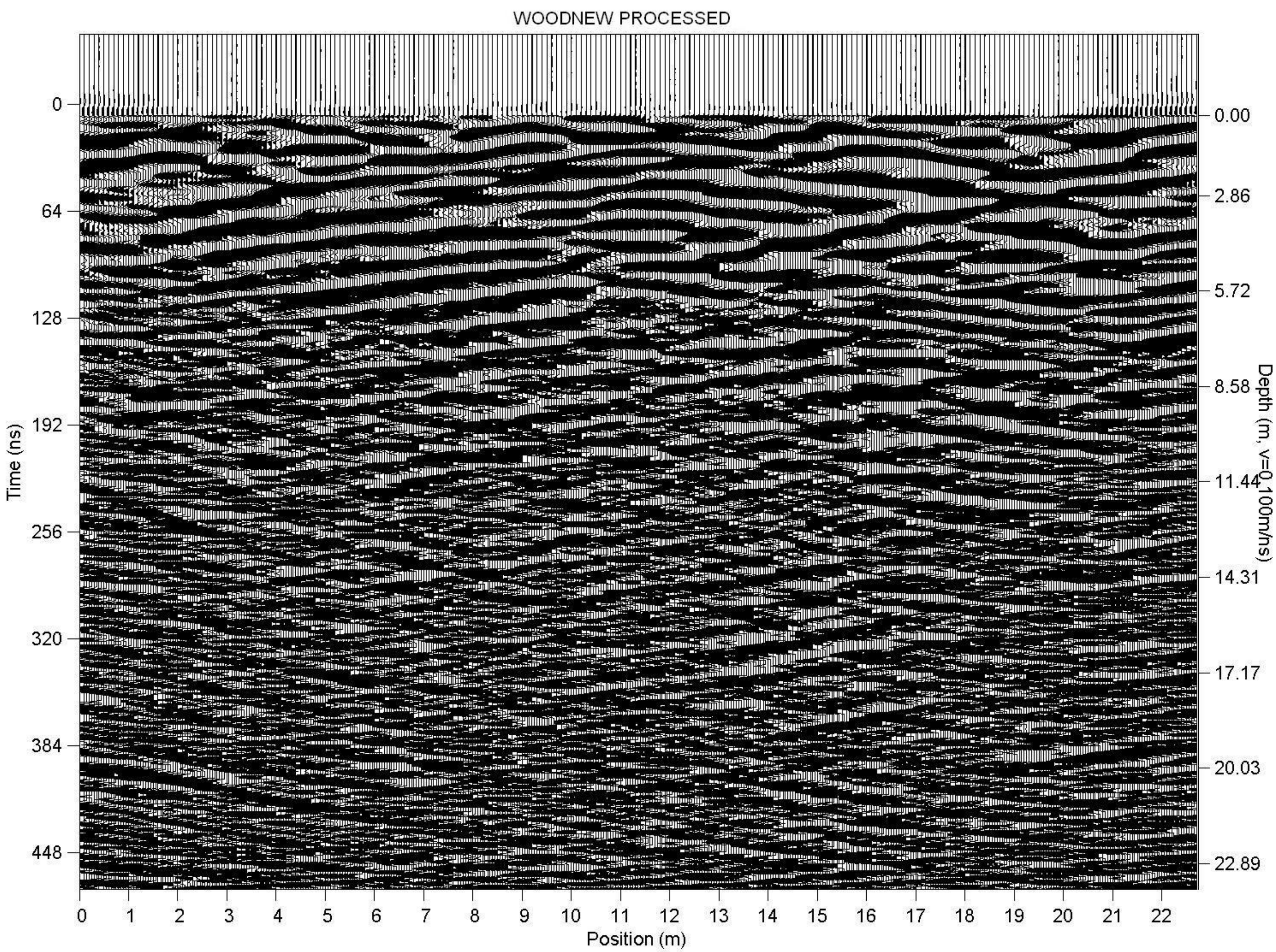

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384
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5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
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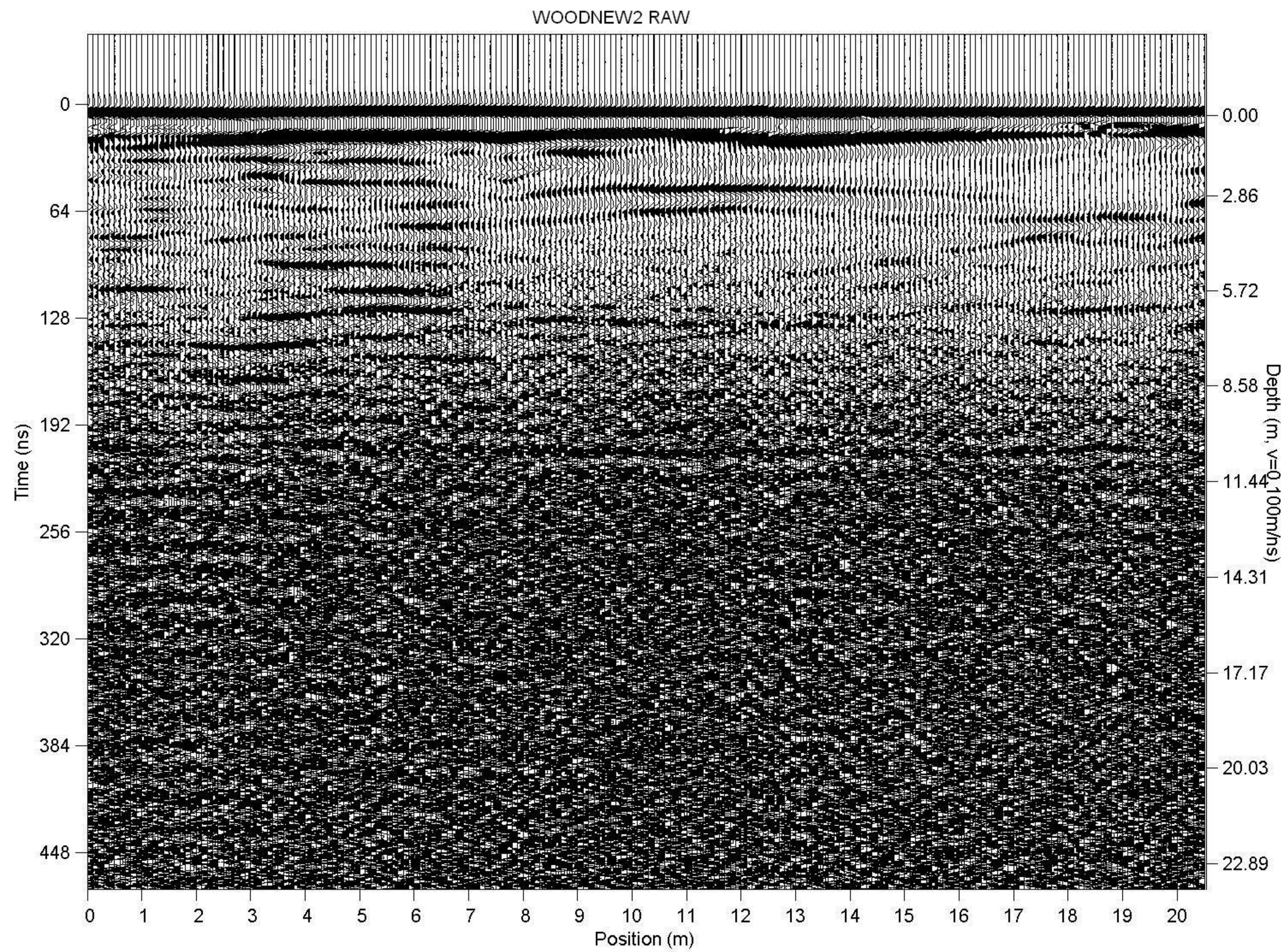
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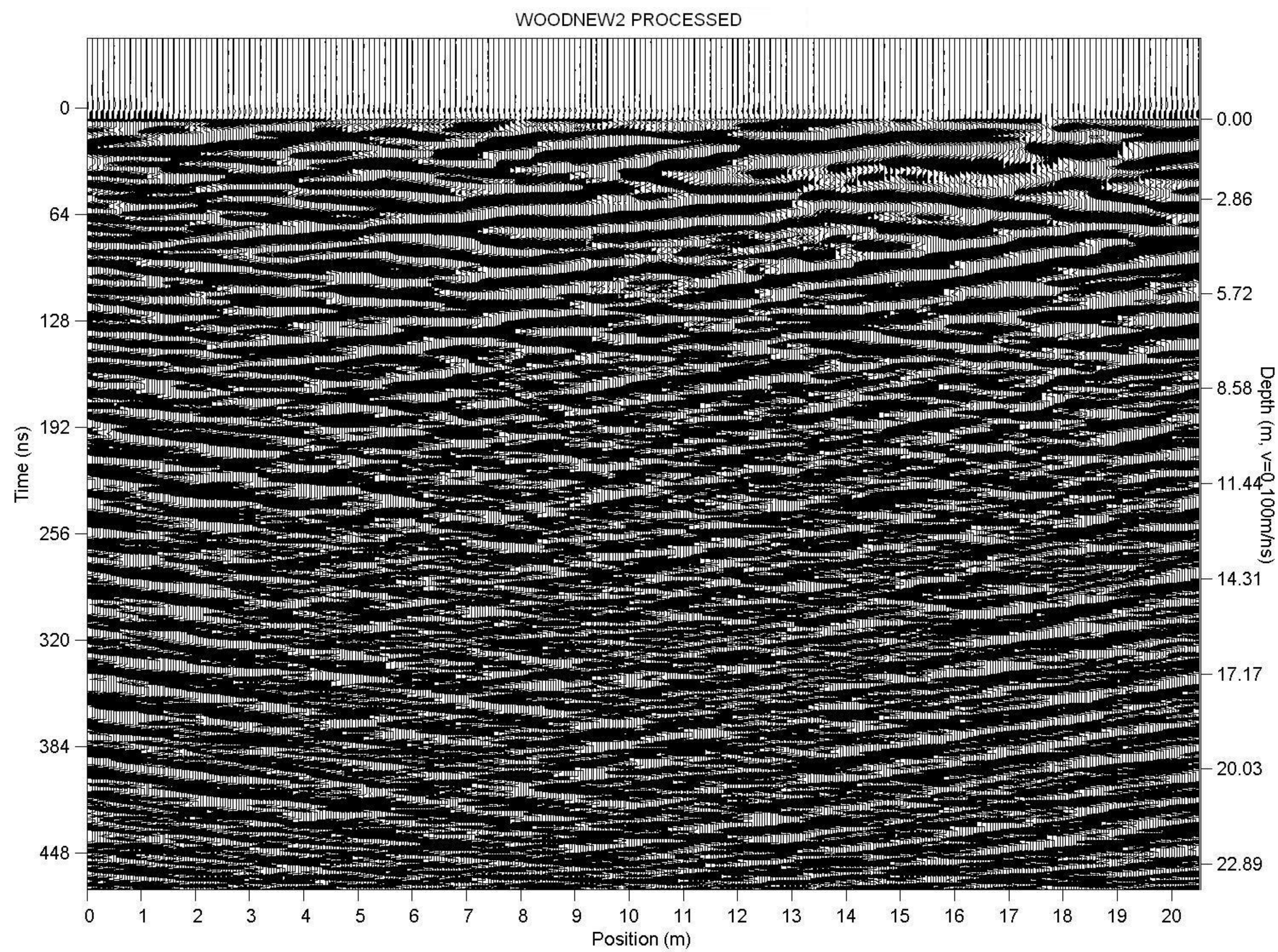
17.17
20.03
22.89
Position (m)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20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22.89
Position (m)
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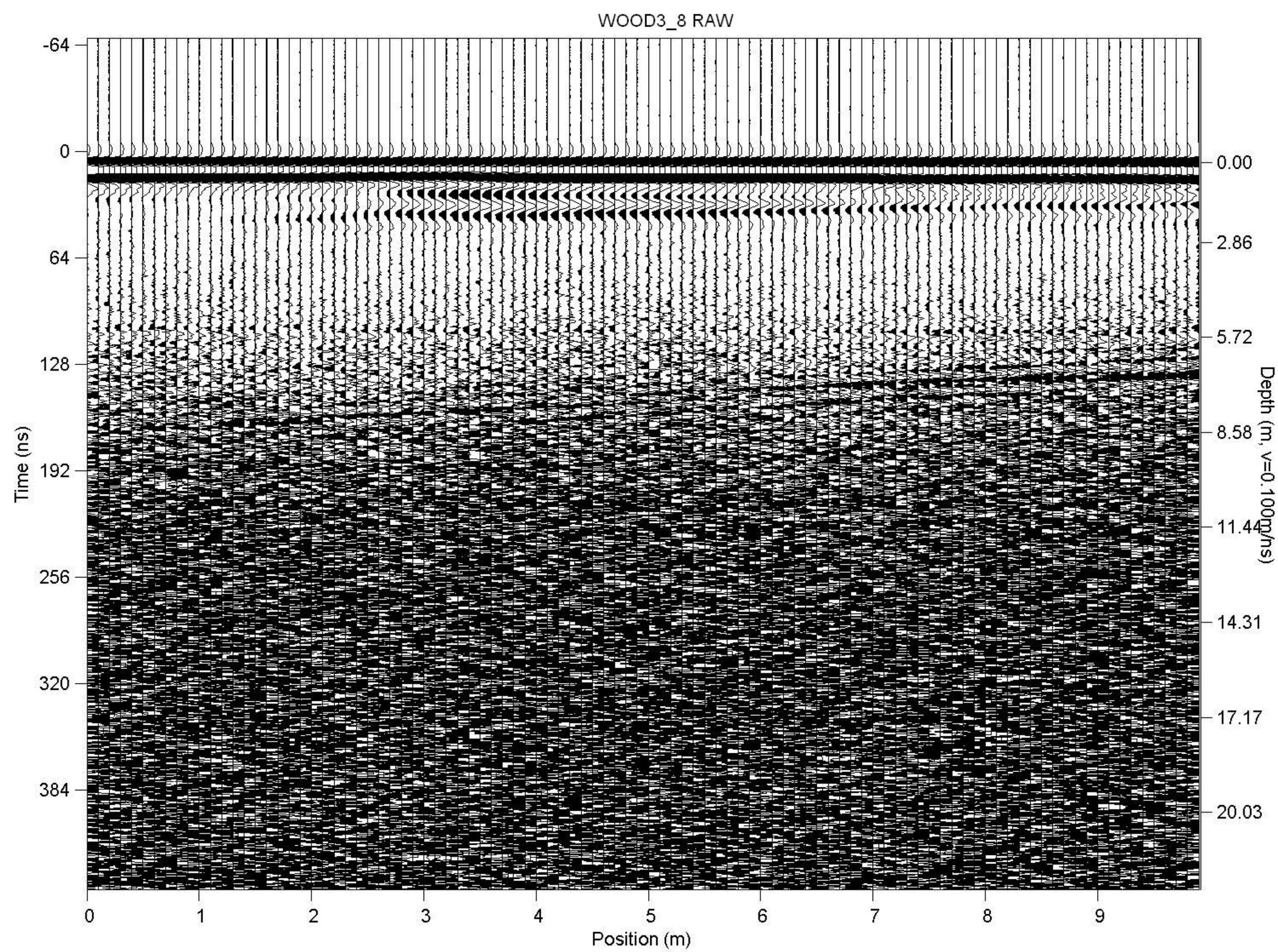
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Depth (m, v=0.100m/ns)
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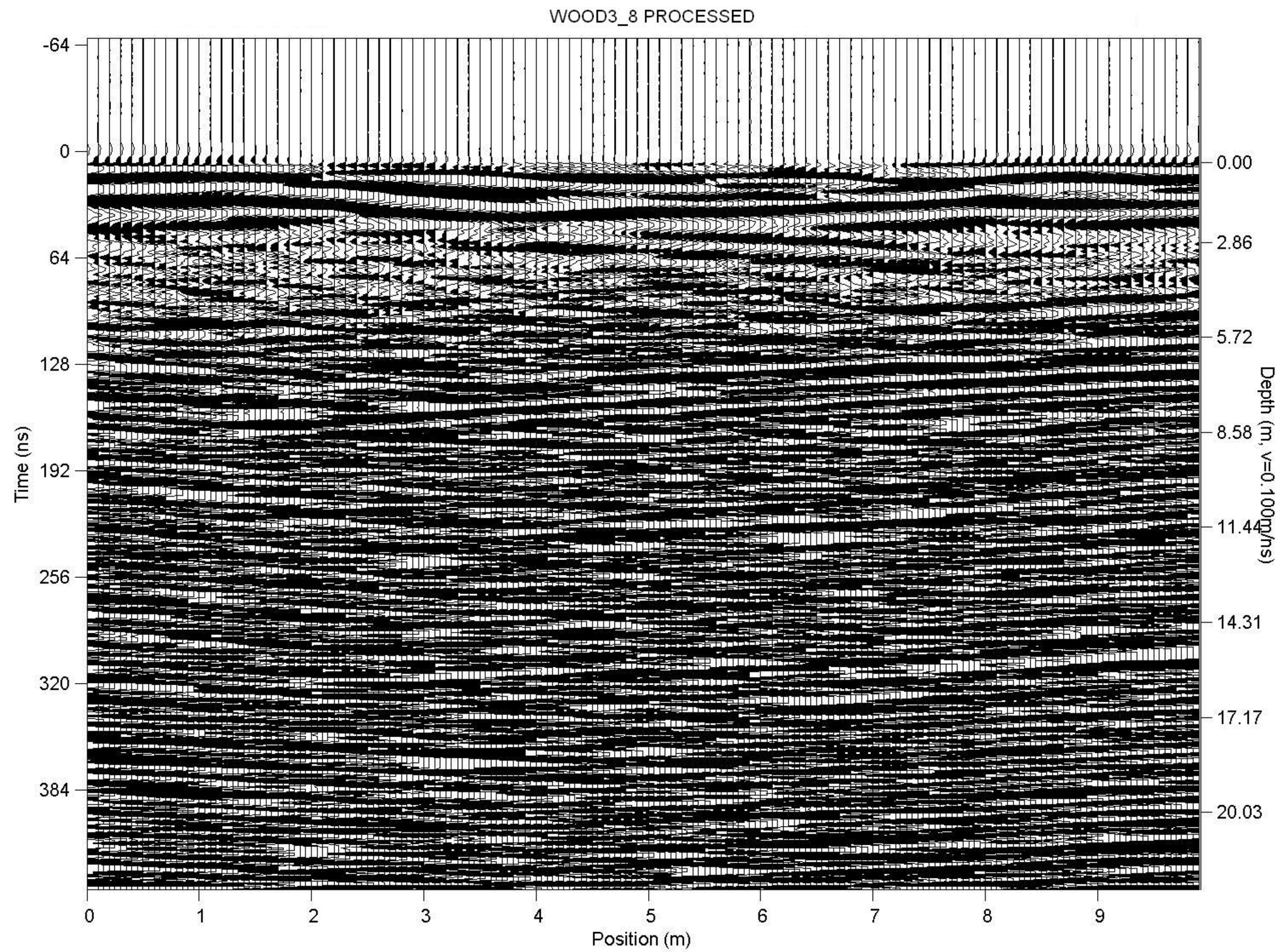
Position (m)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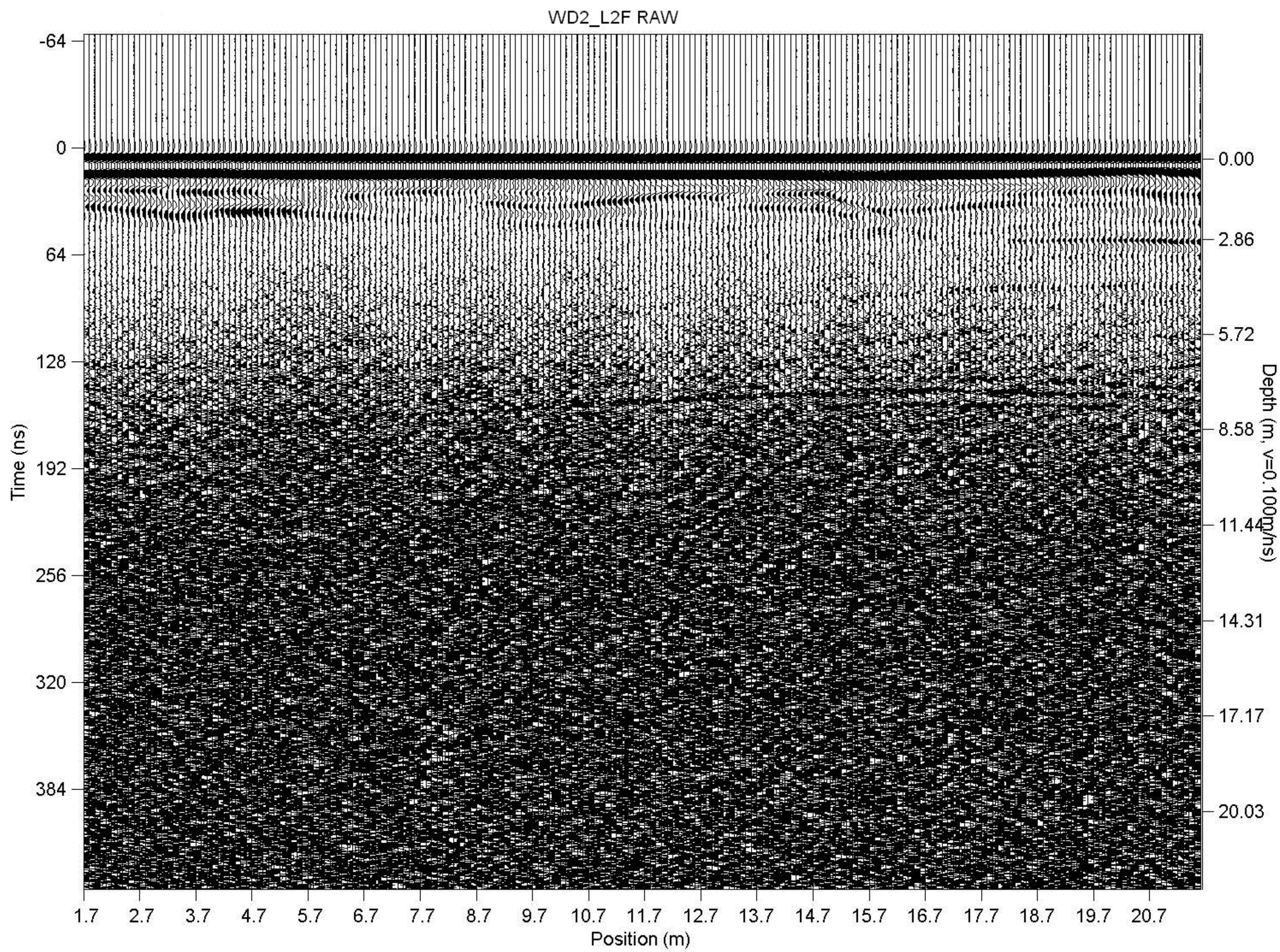
Position (m)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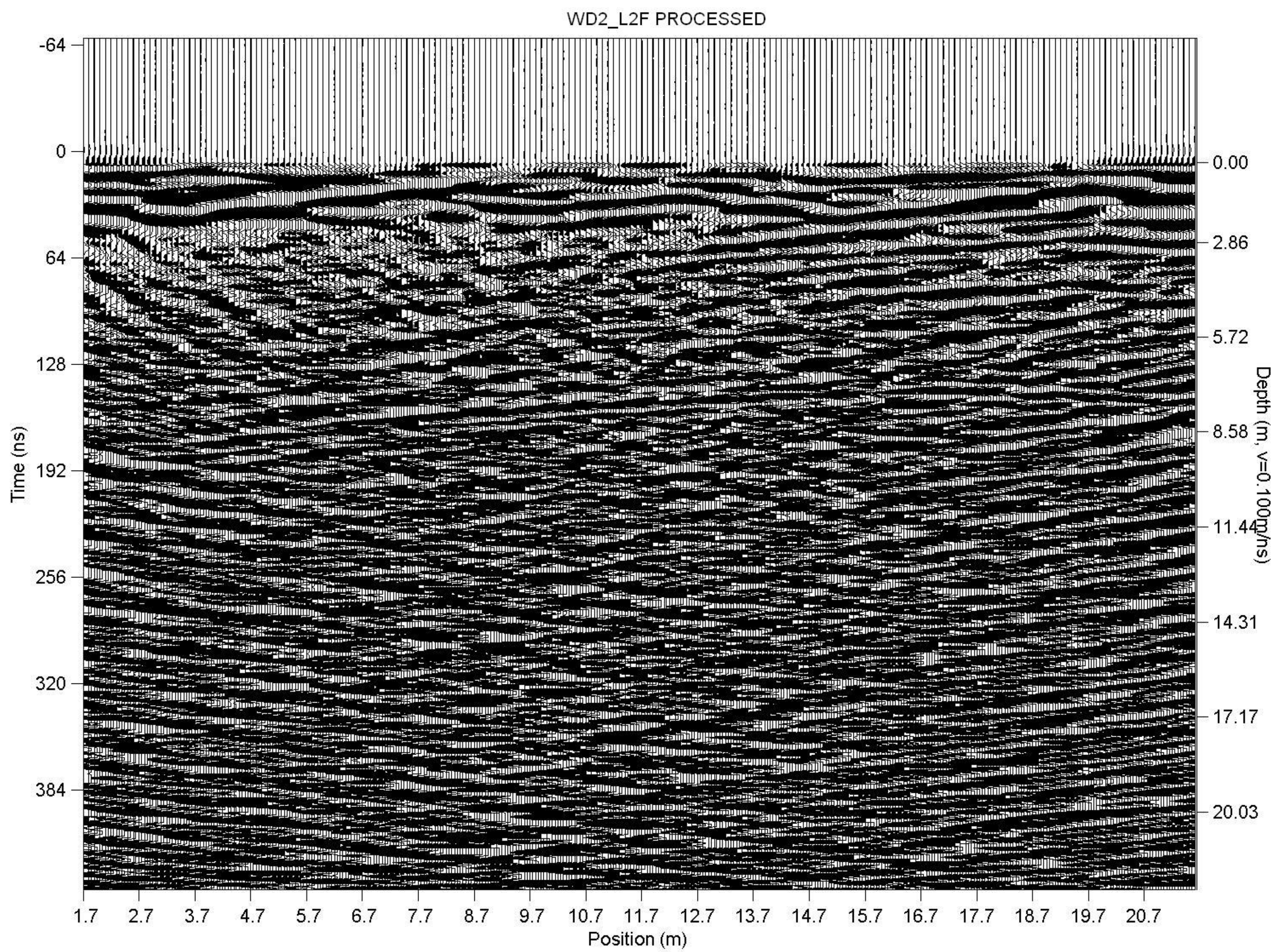
Position (m)



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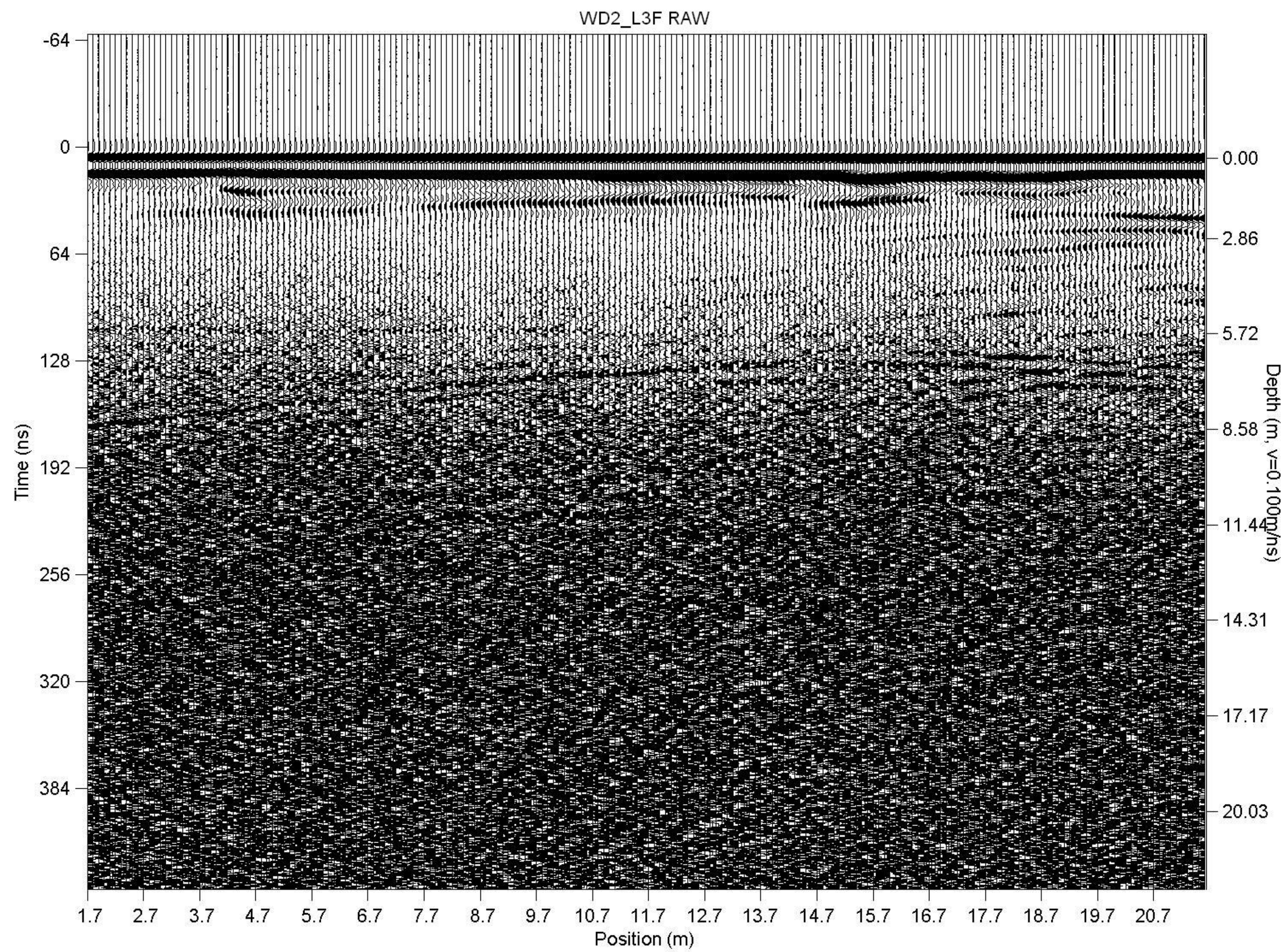
Position (m)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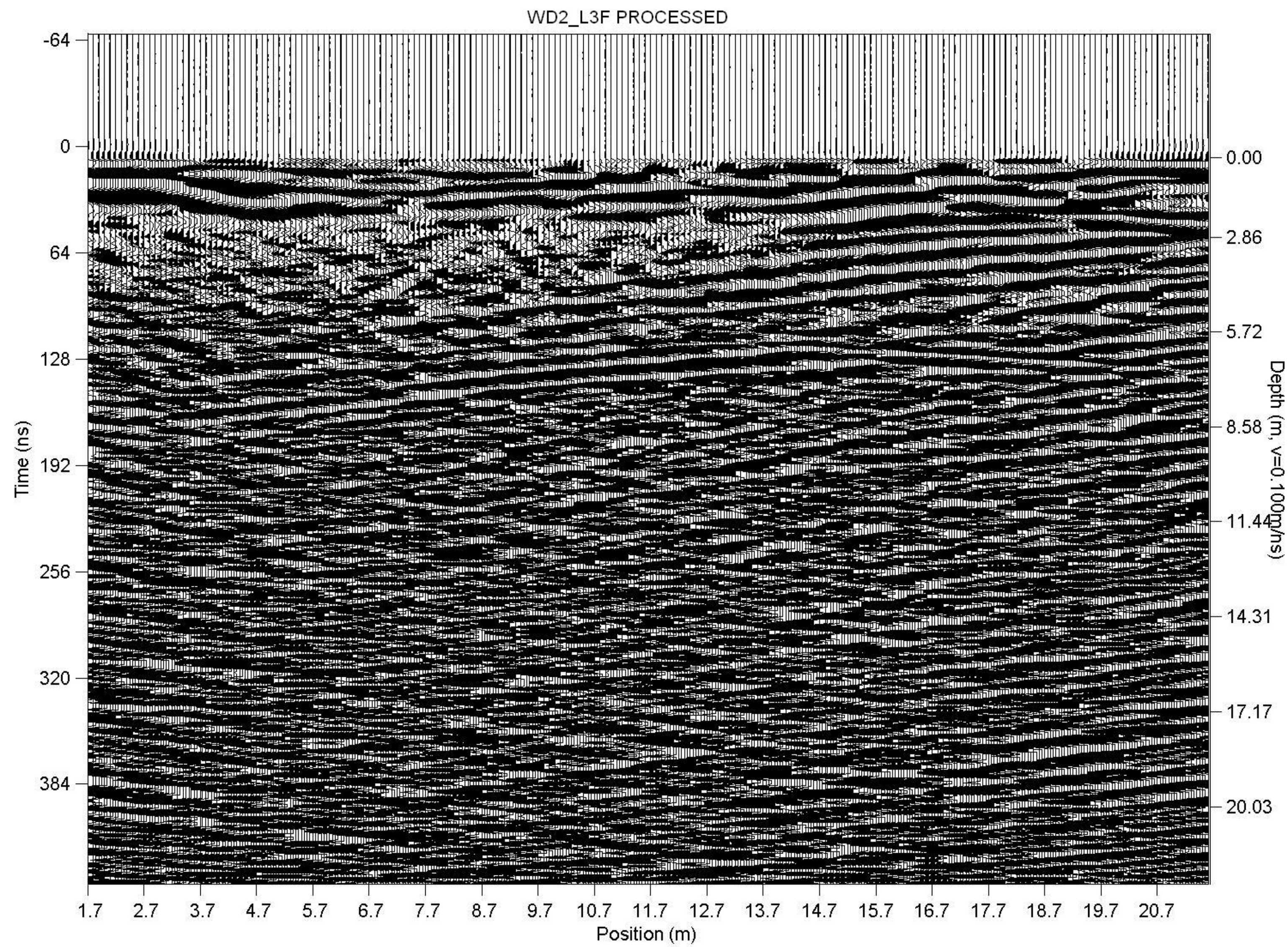
Position (m)



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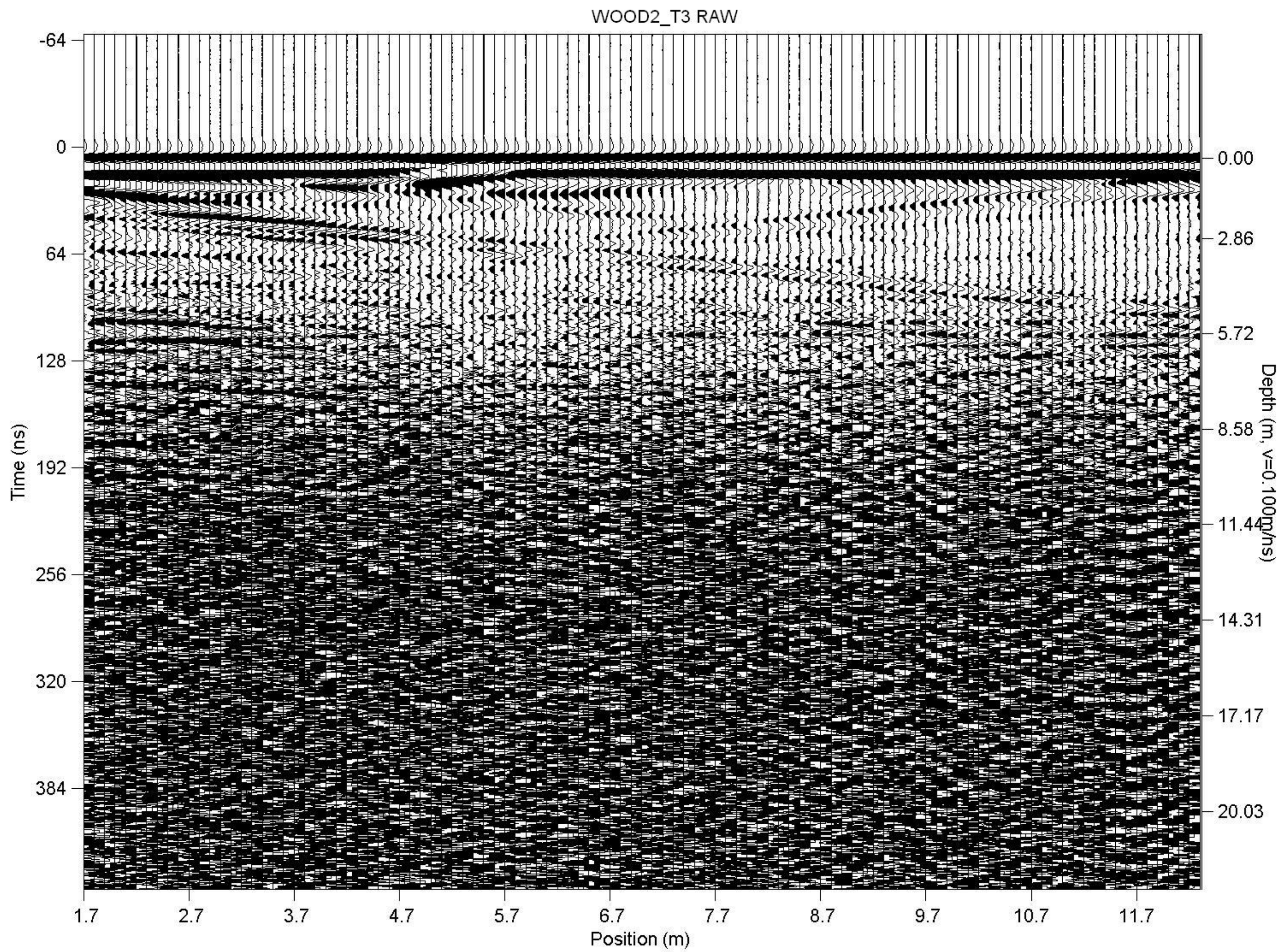
Position (m)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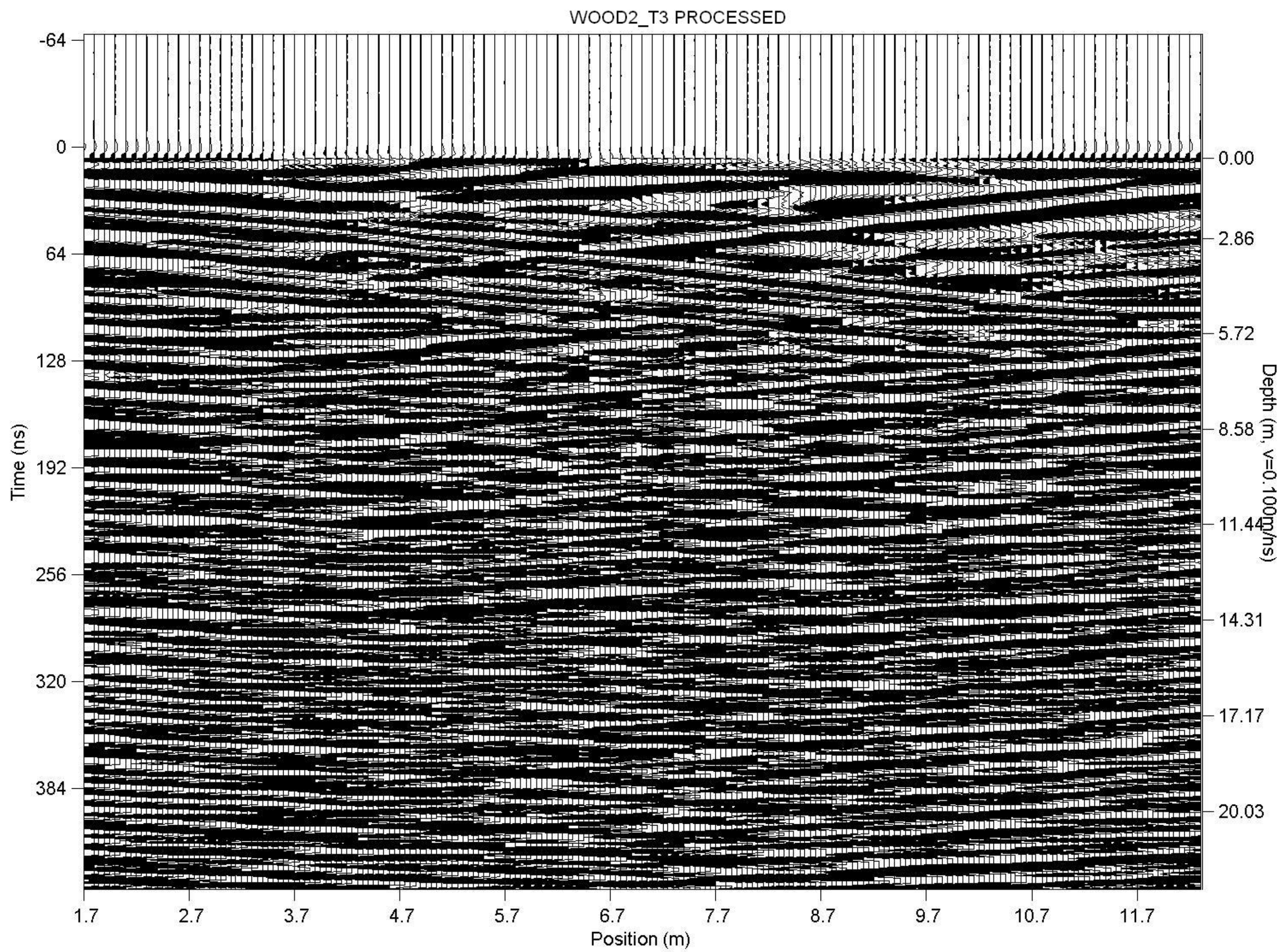
11.7
Position (m)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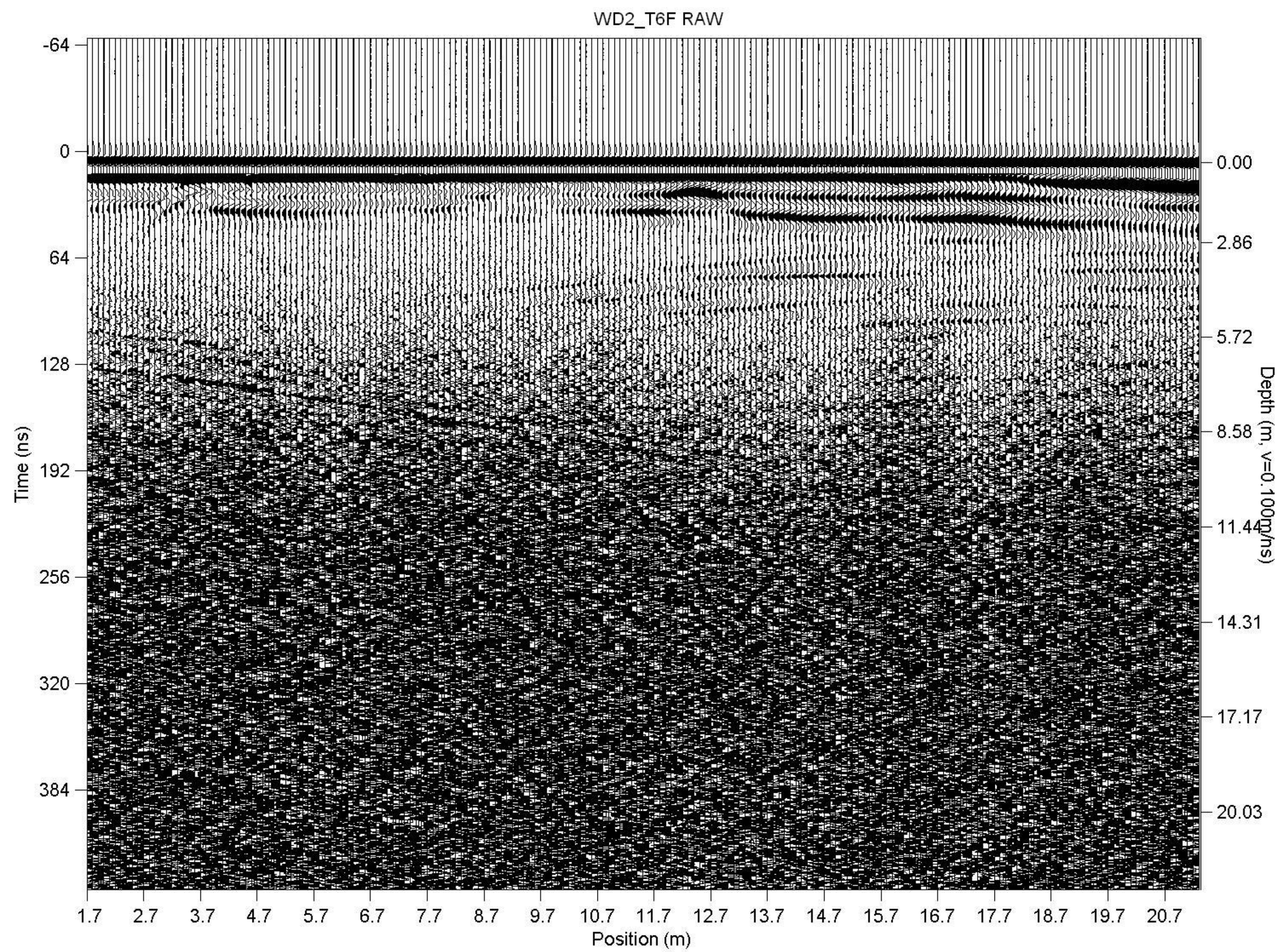

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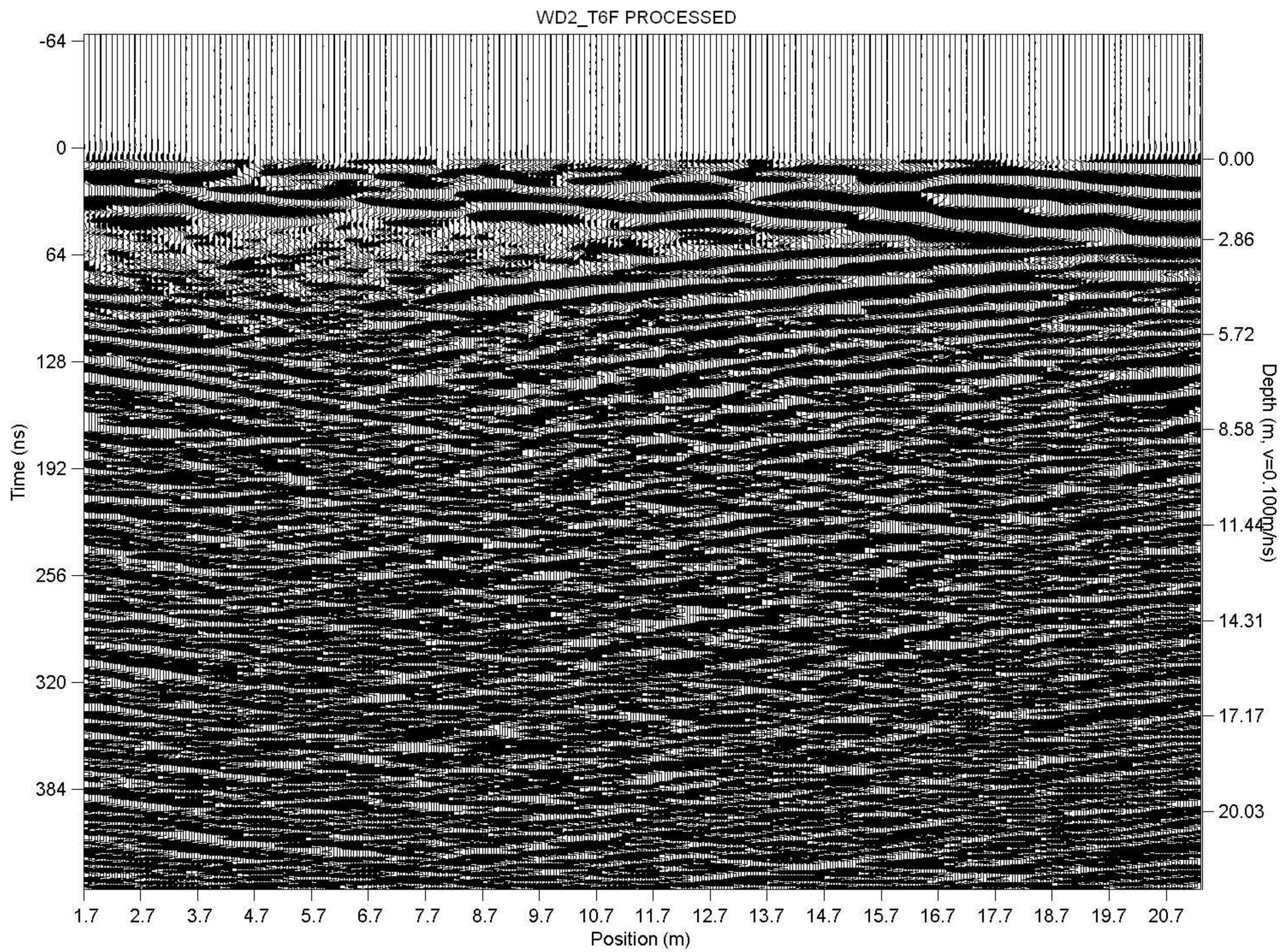
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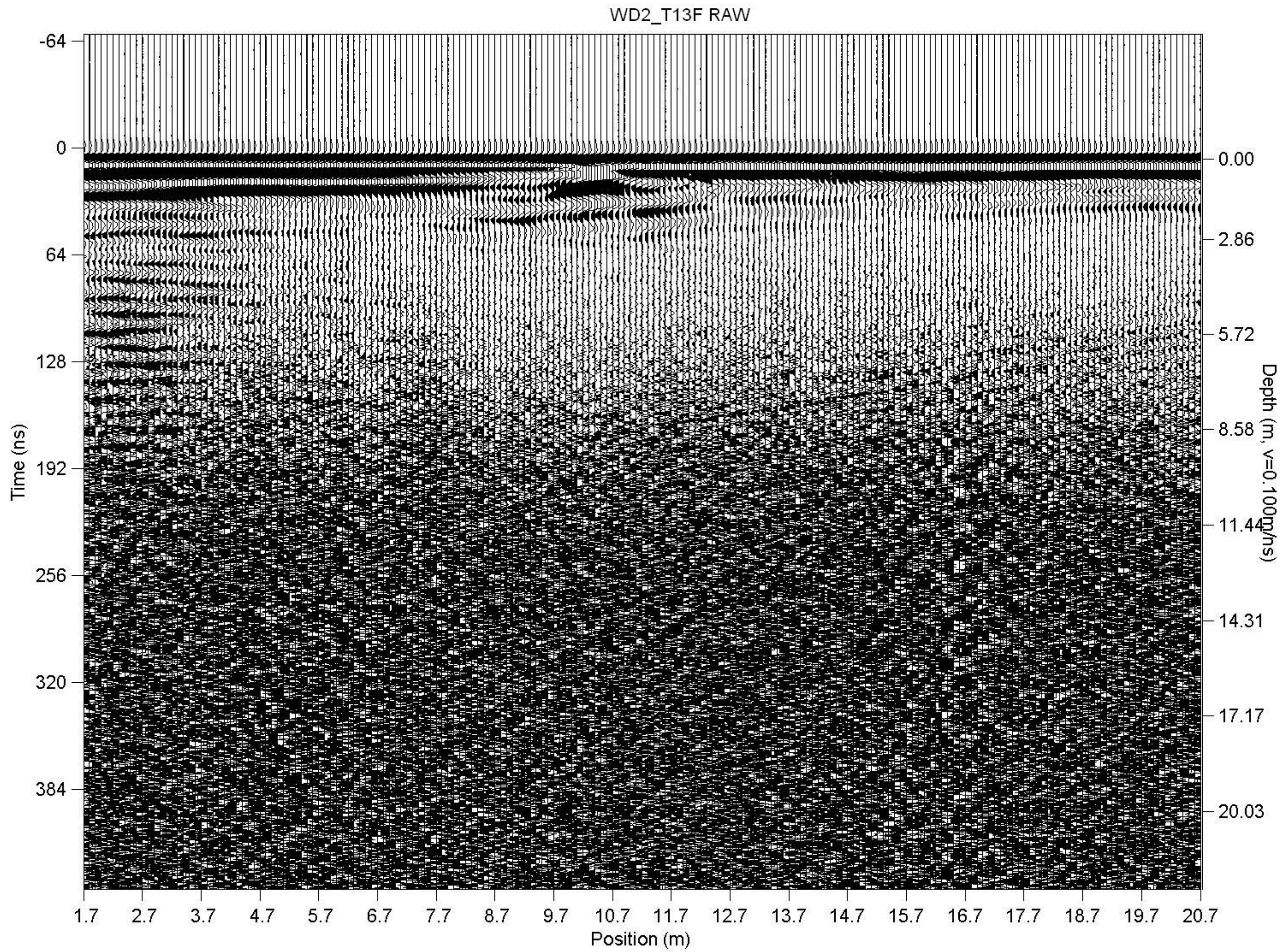

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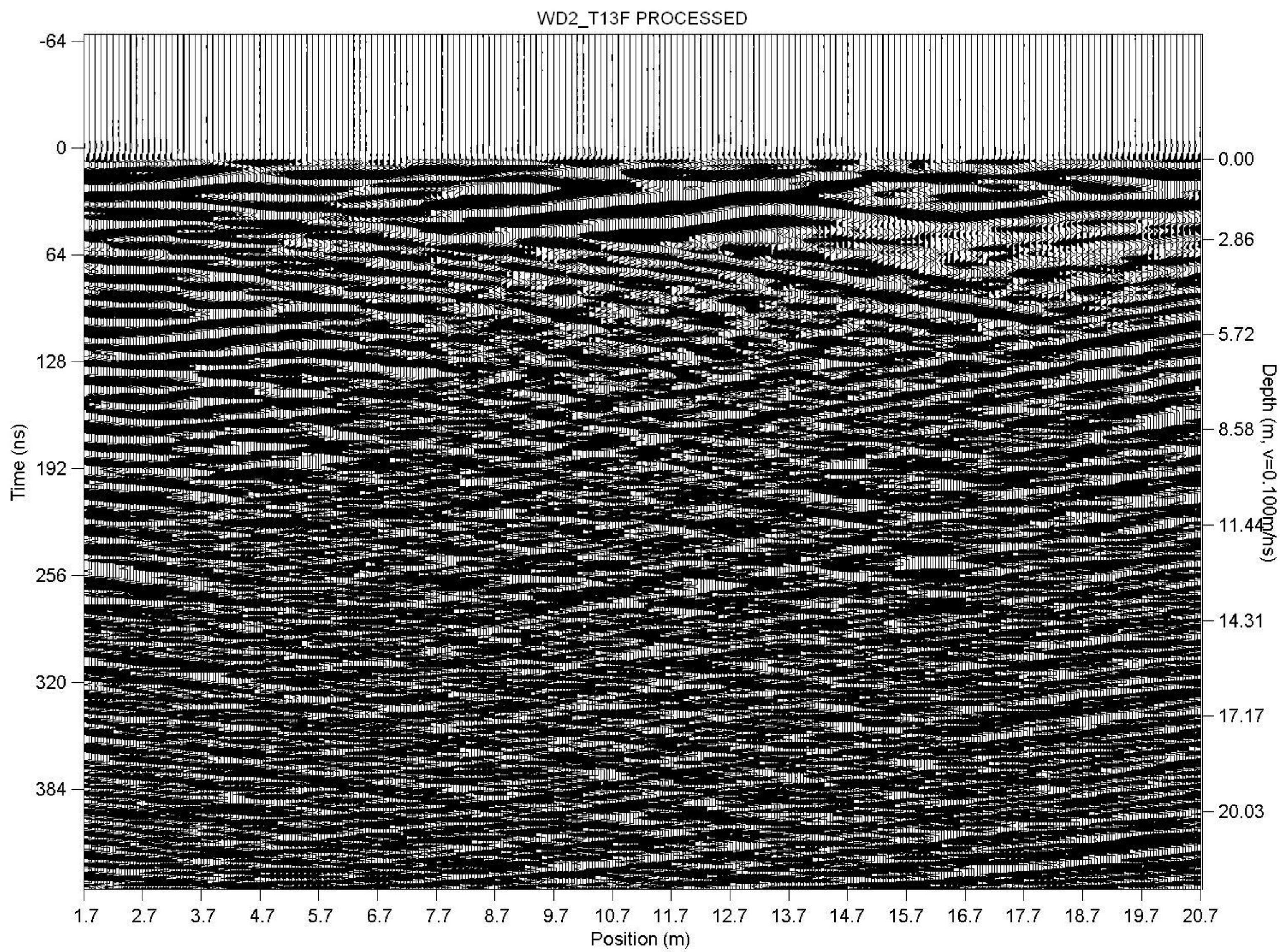
Position (m)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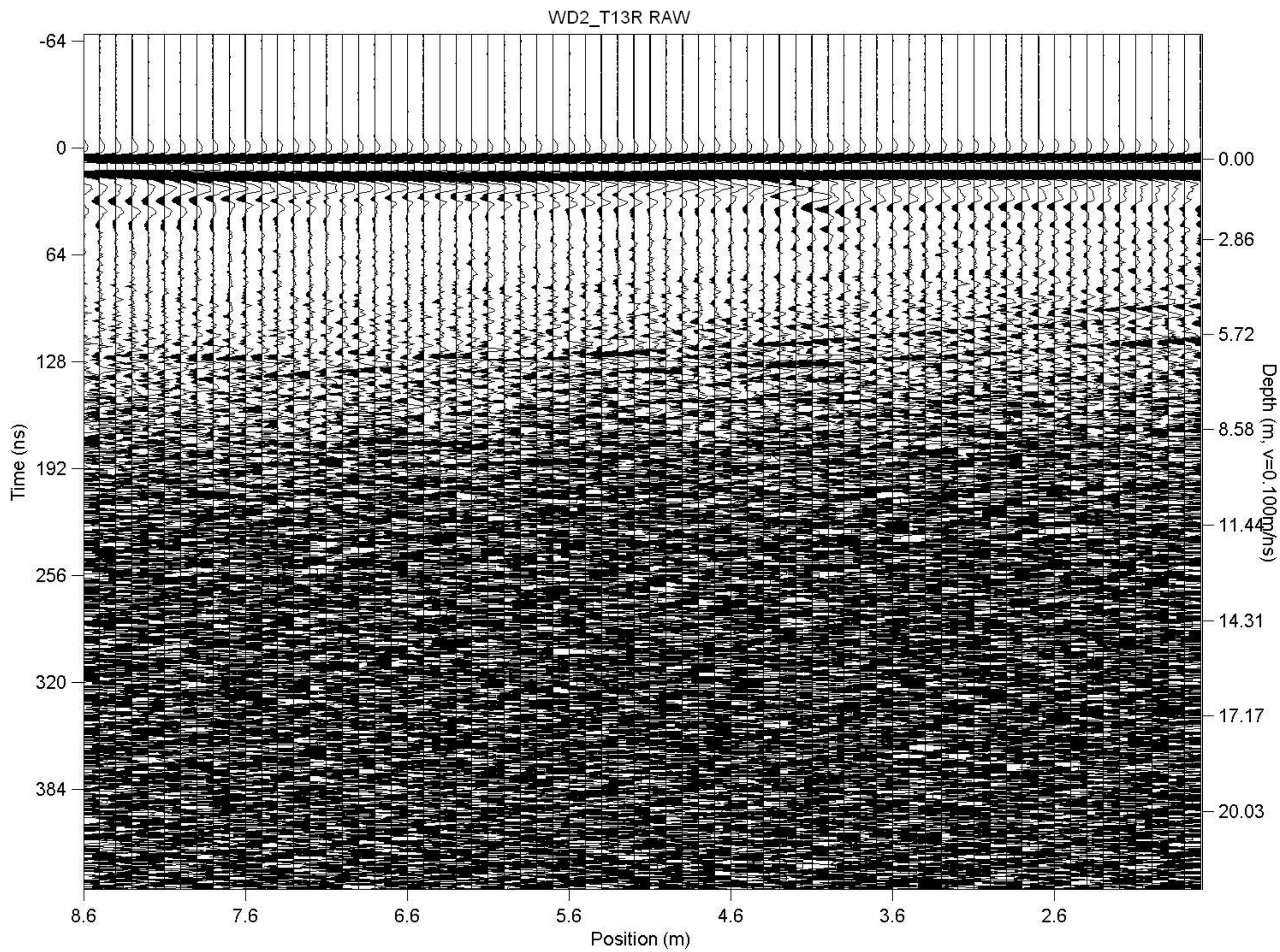
20.7
Position (m)



WD2_T13R RAW
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192
256
320
384
Depth (m, v=0.100m/ns)
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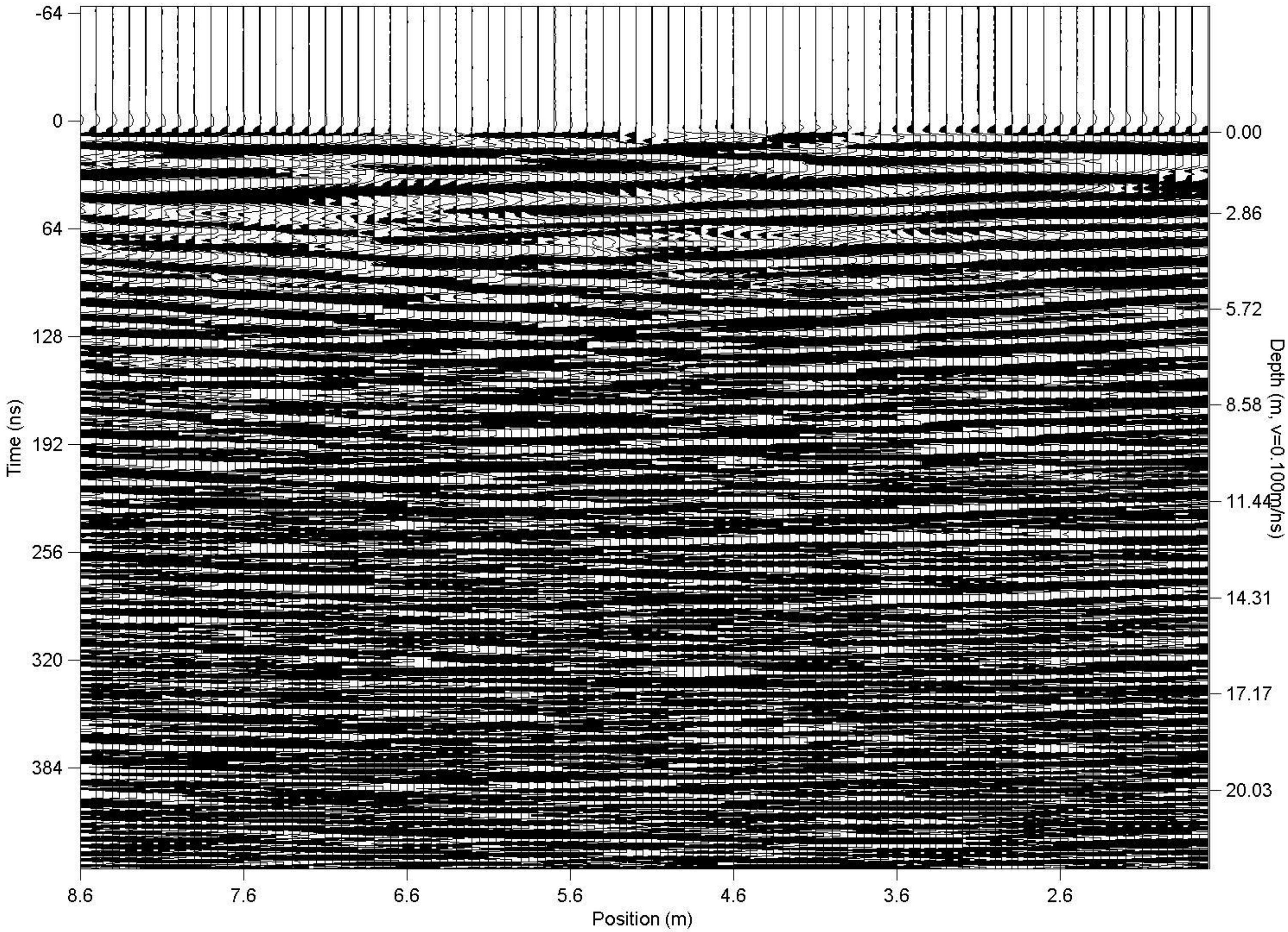
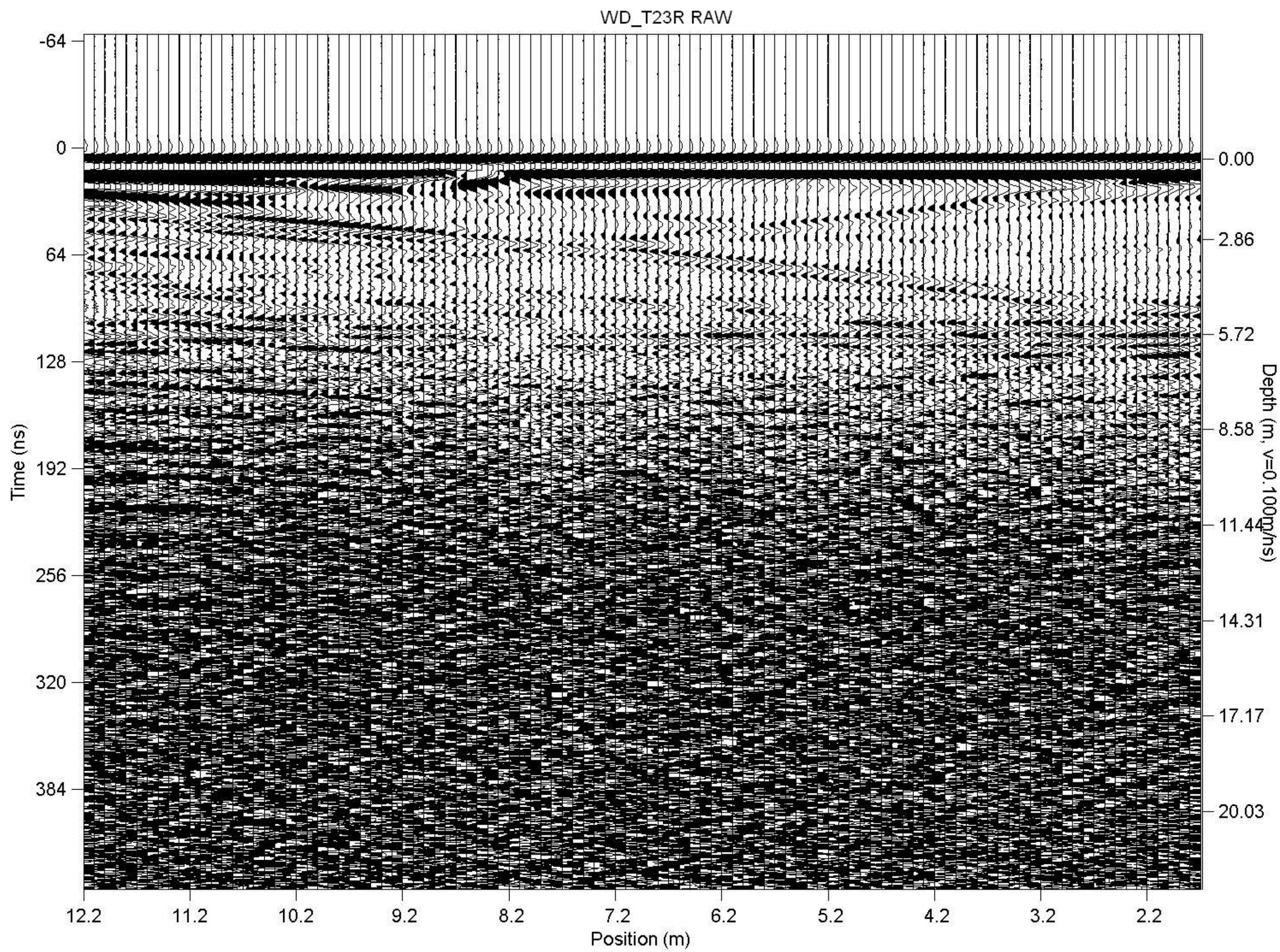
2.86
5.72
8.58
11.44
14.31
17.17
20.03
Position (m)
8.6
7.6
6.6
5.6
4.6
3.6
2.6

WD2_T13R PROCESSED

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192
256
320
384
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2.86
5.72
8.58
11.44
14.31
17.17
20.03
12.2
11.2
10.2
9.2
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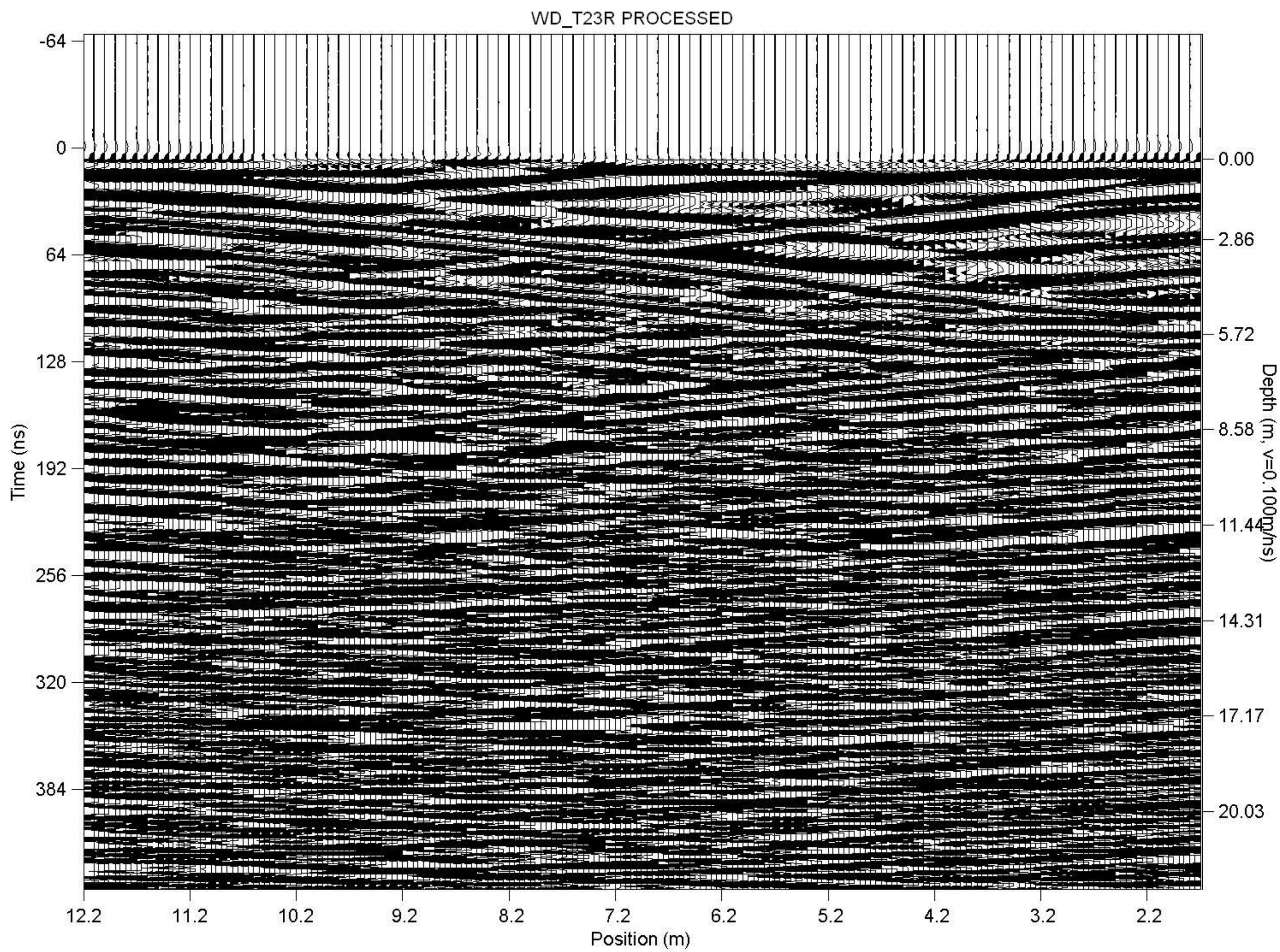
3.2
2.2
Position (m)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128
192
256
320
384
Depth (m, v=0.100m/ns)
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2.86
5.72
8.58
11.44
14.31
17.17
20.03
12.2
11.2
10.2
9.2
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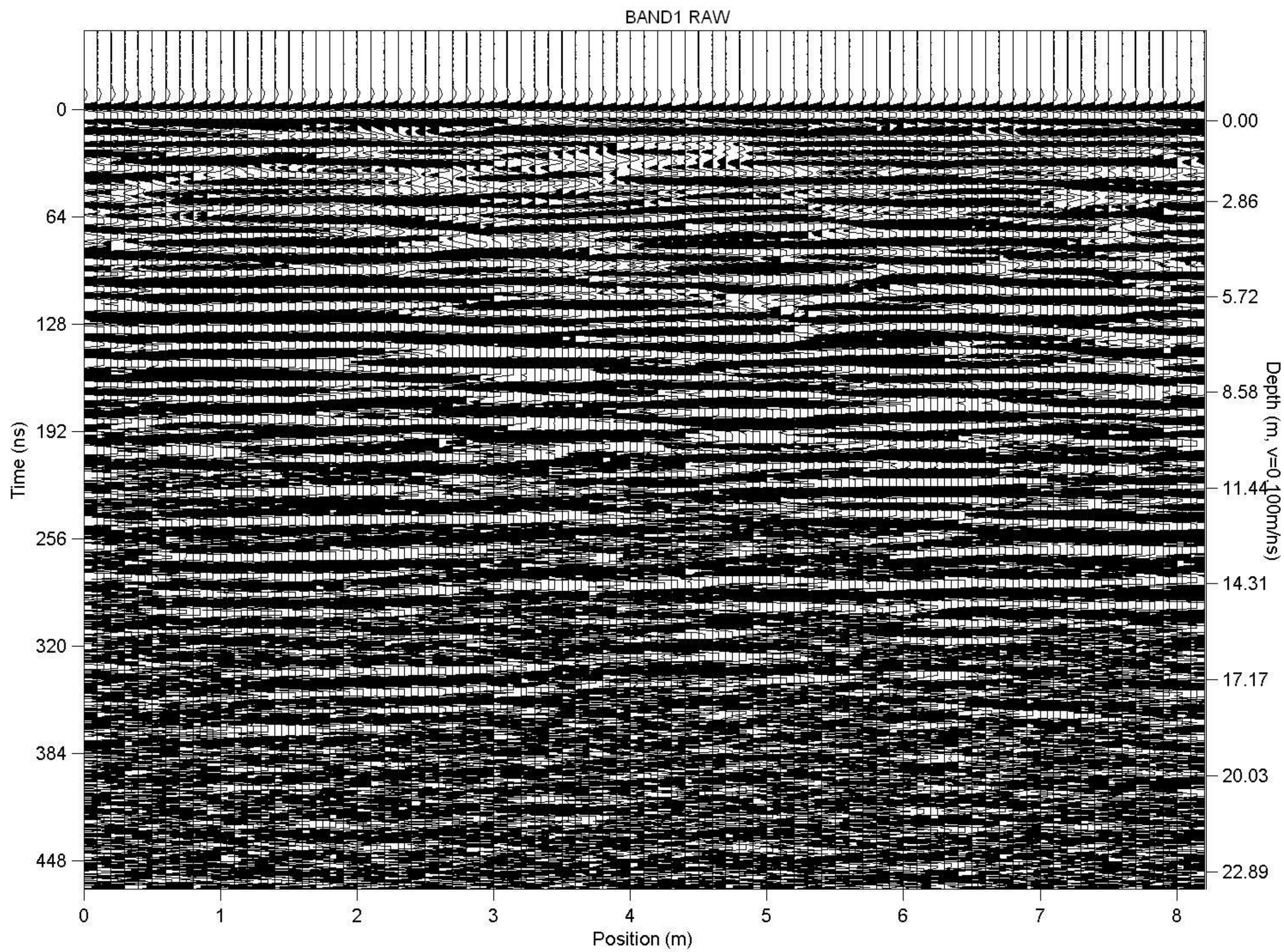
3.2
2.2
Position (m)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256
320
384
448
Depth (m, v=0.100m/ns)
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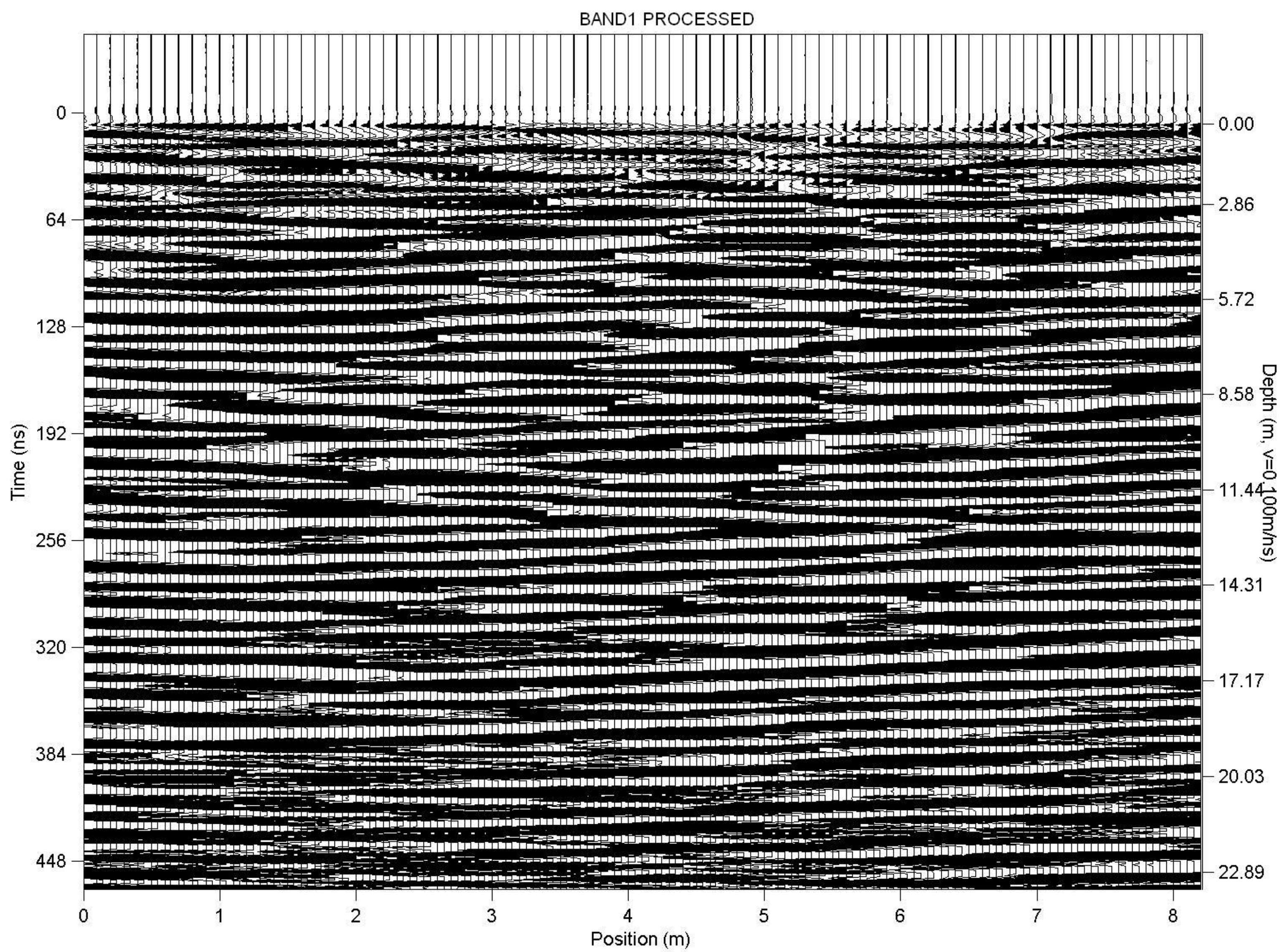
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
3
4
5
6
7
8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Time (ns)
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192
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320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
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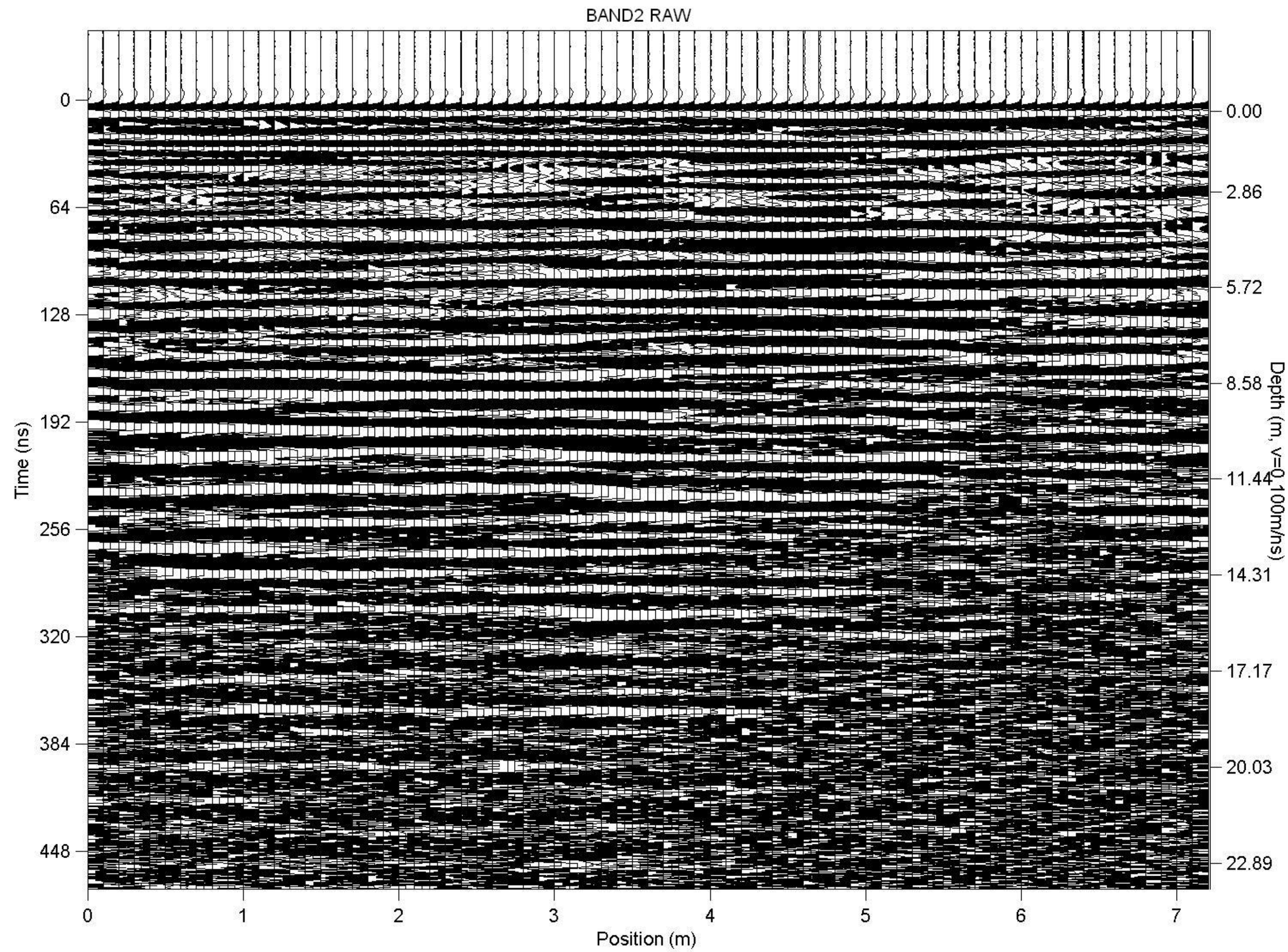
4
5
6
7
8


BAND2 RAW
Time (ns)
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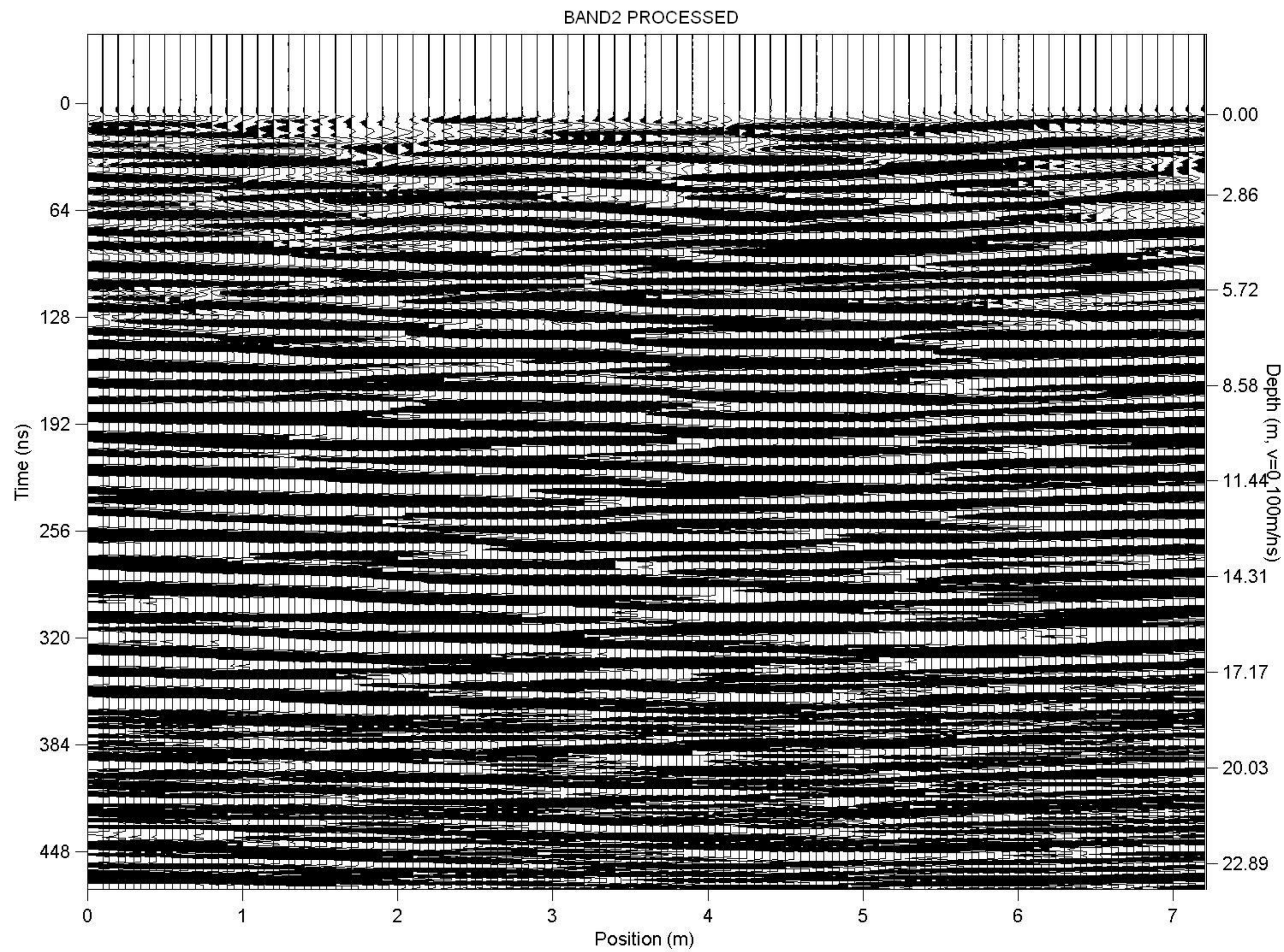
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
3
4
5
6
7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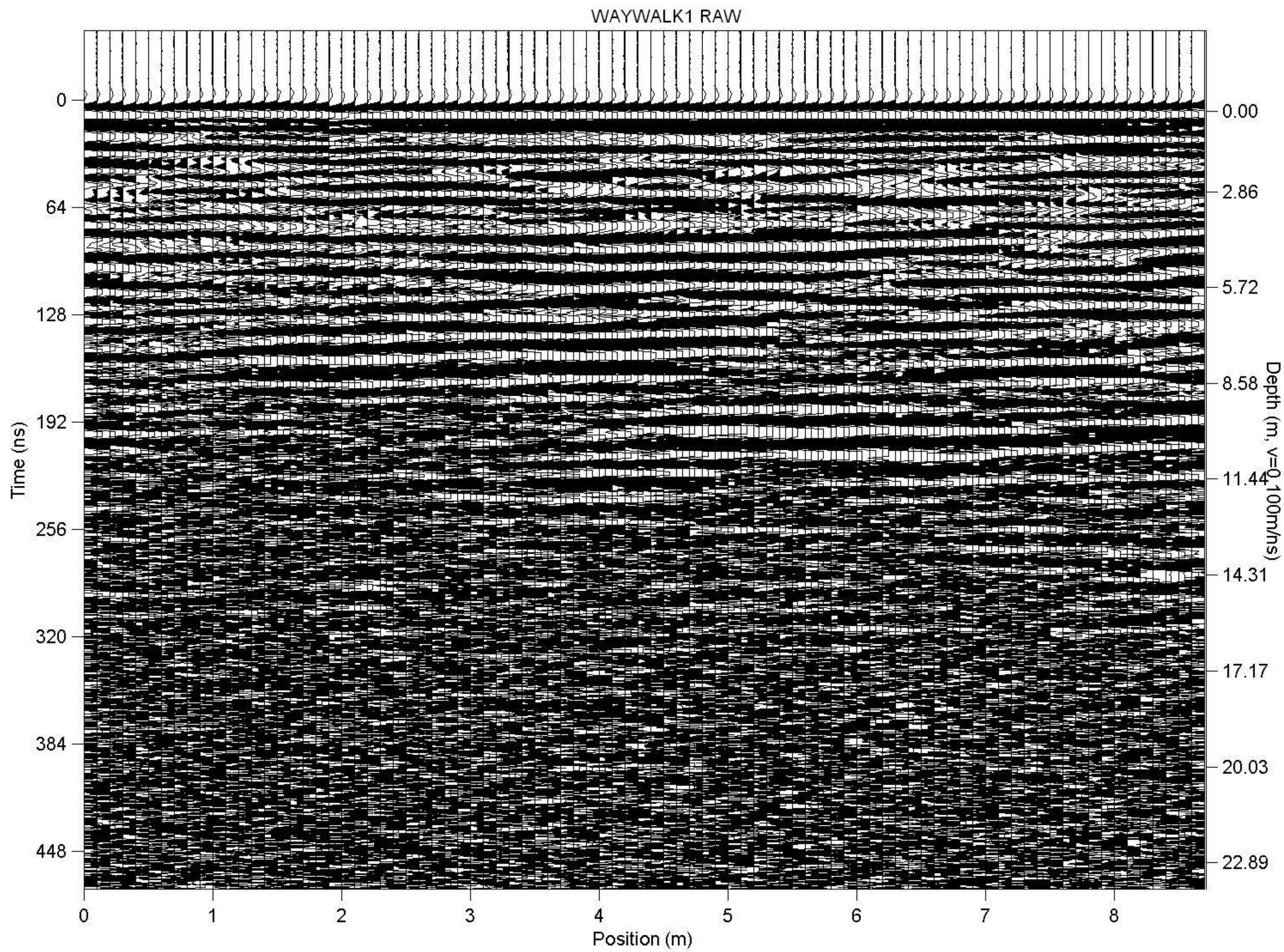
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
3
4
5
6
7


WAYWALK1 RAW
Time (ns)
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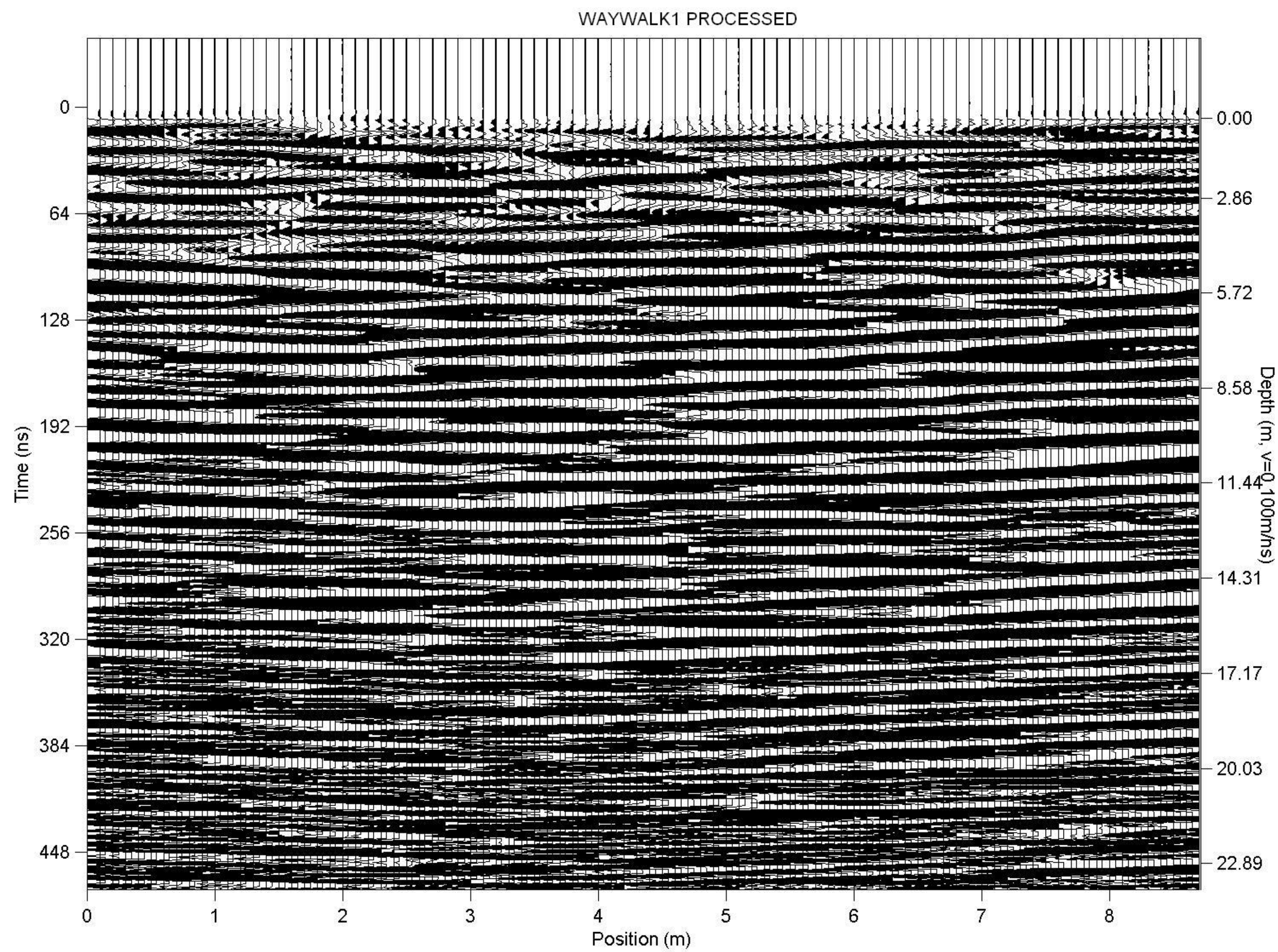
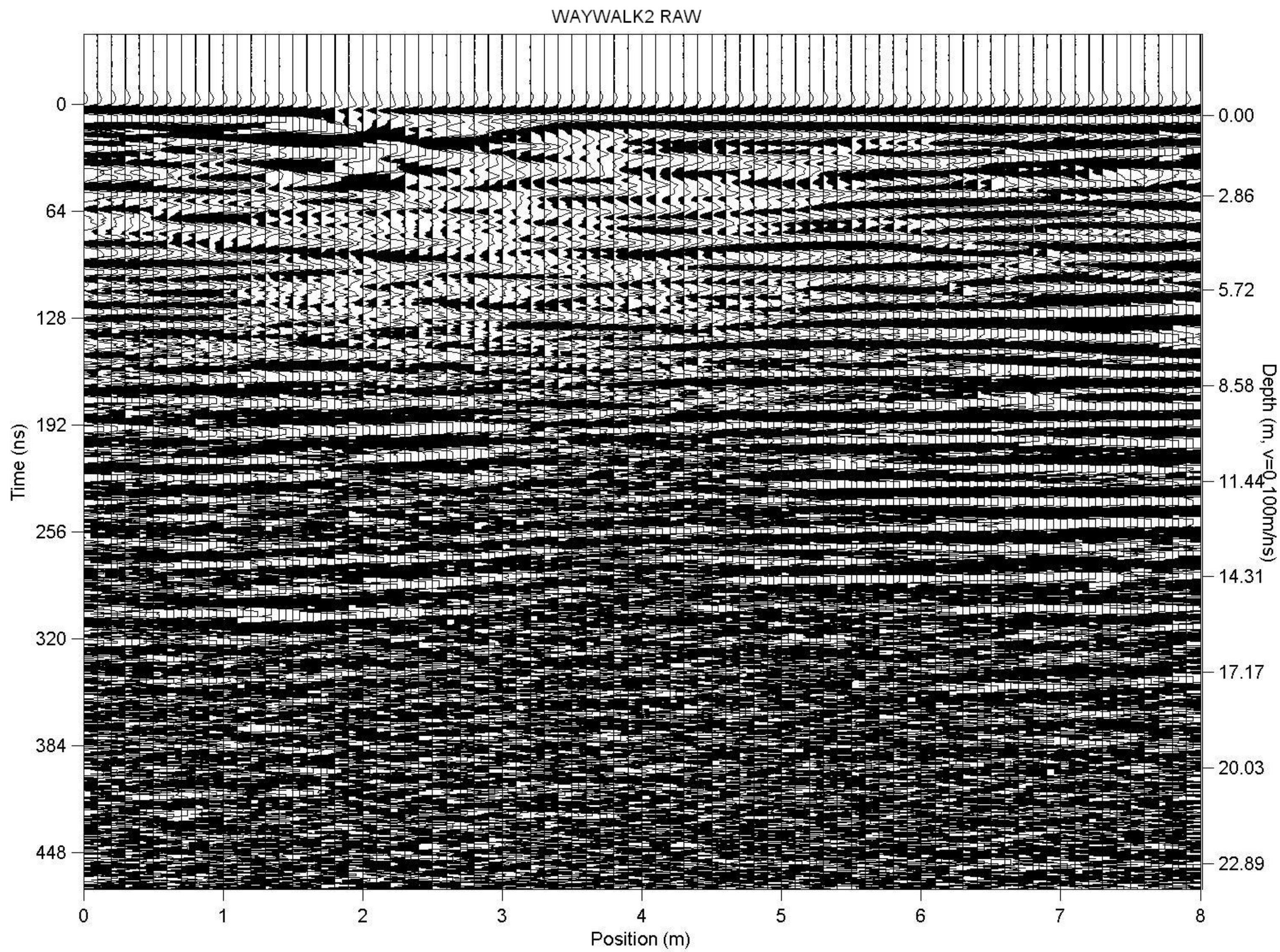
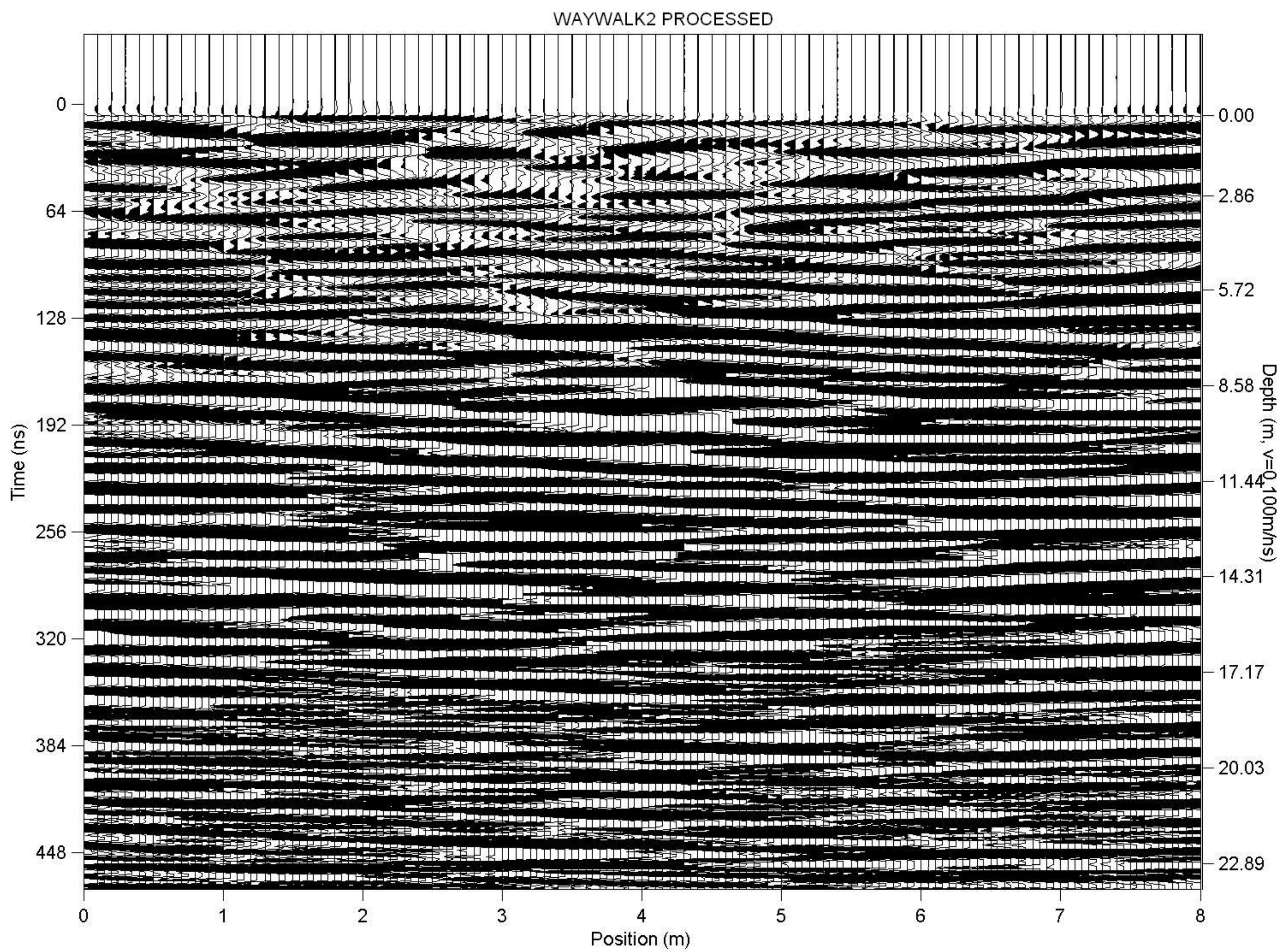
128
192
256
320
384
448
Position (m)
0
1
2
3
4
5
6
7
8
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89


WAYWALK1 PROCESSED
Time (ns)
0
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
3
4
5
6
7
8


WAYWALK2 RAW
Time (ns)
0
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
0
1
2
3
4
5
6
7
8
Position (m)


WAYWALK2 PROCESSED
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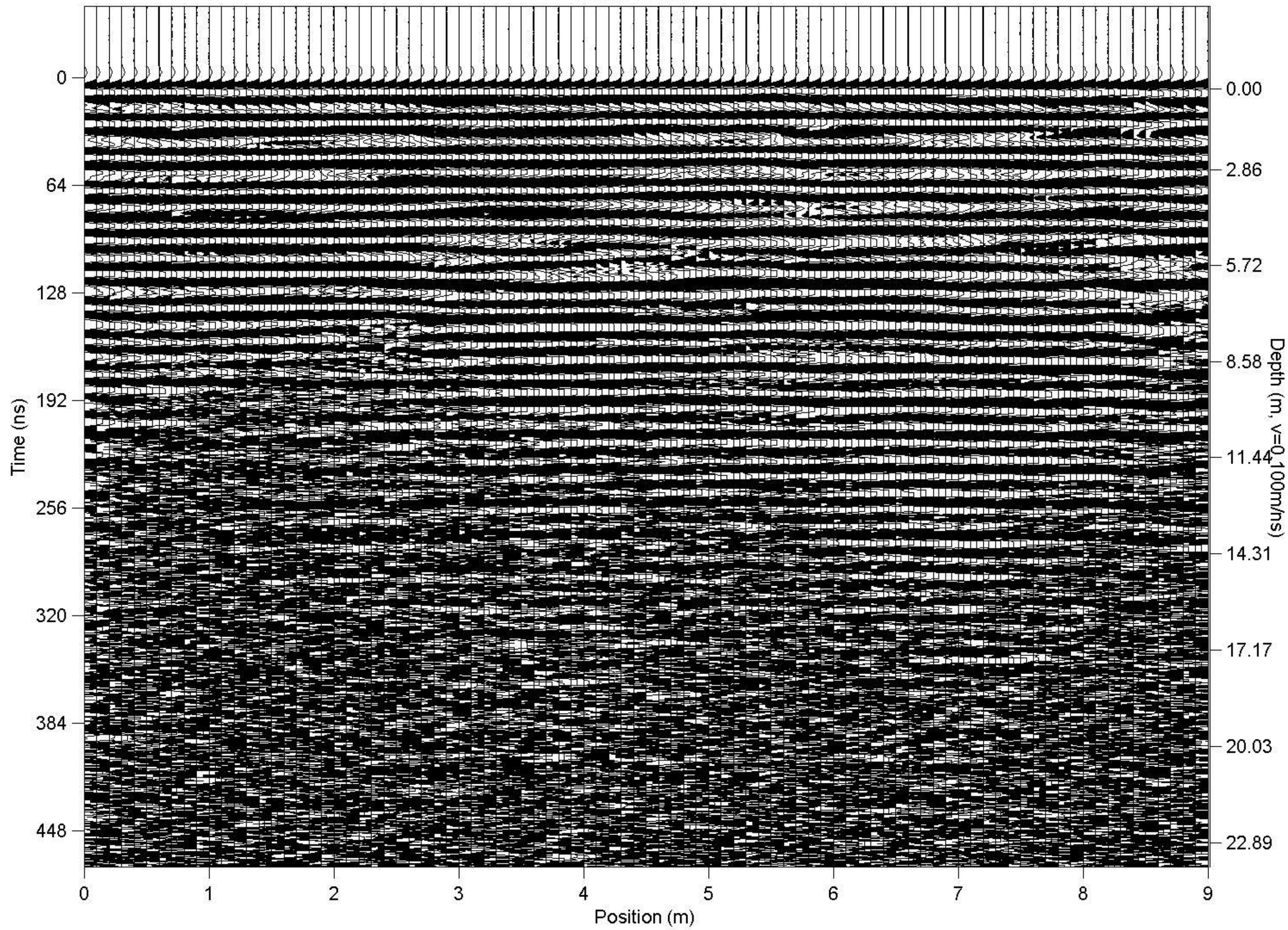
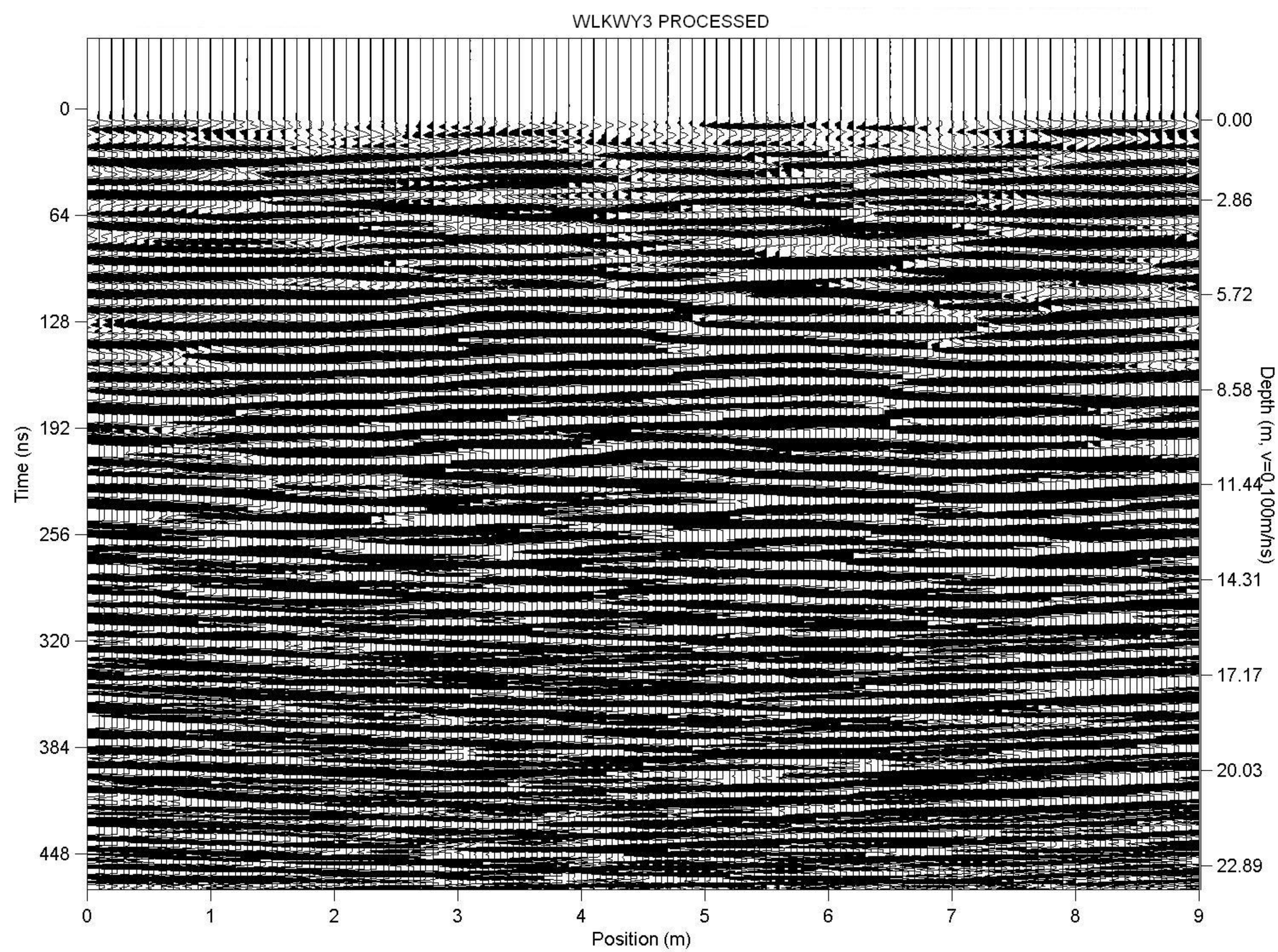
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
3
4
5
6
7
8

WLKWY3 RAW


Time (ns)
0
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
0
1
2
3
4
5
6
7
8
9
Position (m)


WLKWY3 PROCESSED
Time (ns)
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128
192
256
320
384
448
Depth (m, v=0.100m/ns)
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2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
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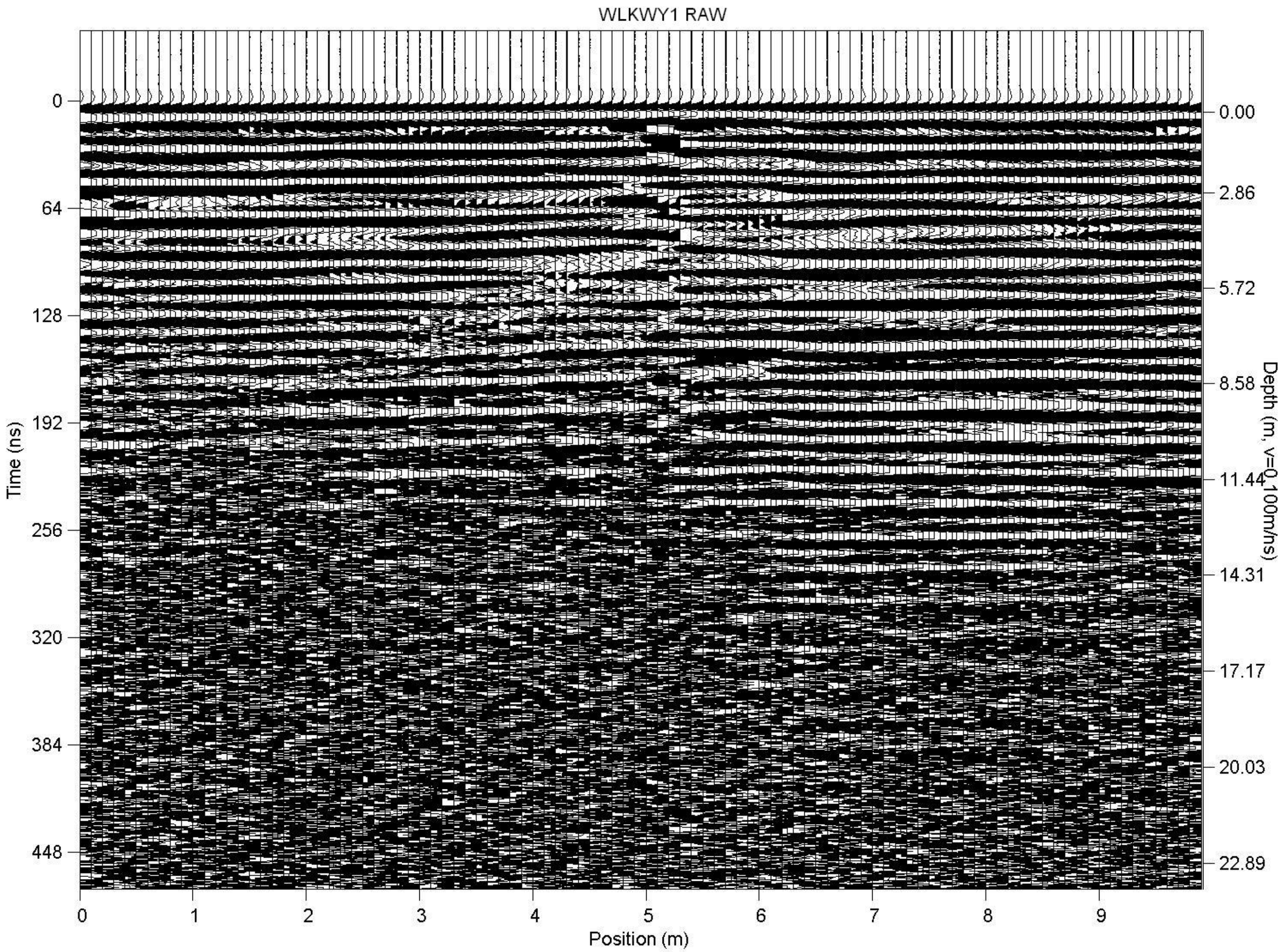
4
5
6
7
8
9


WLKWY1 RAW
Time (ns)
0
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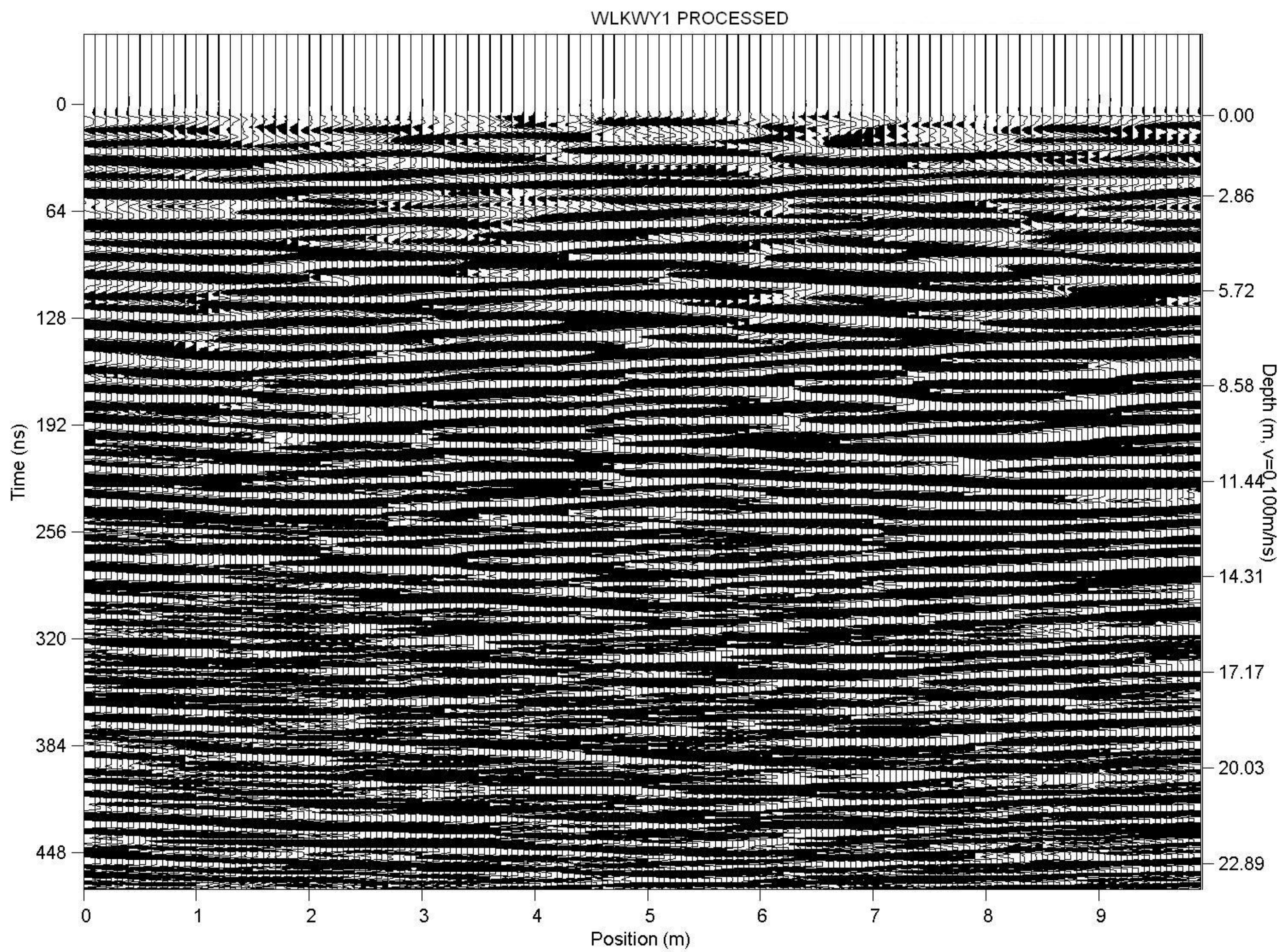
128
192
256
320
384
448
Position (m)
0
1
2
3
4
5
6
7
8
9
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89


WLKWY1 PROCESSED
Time (ns)
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64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
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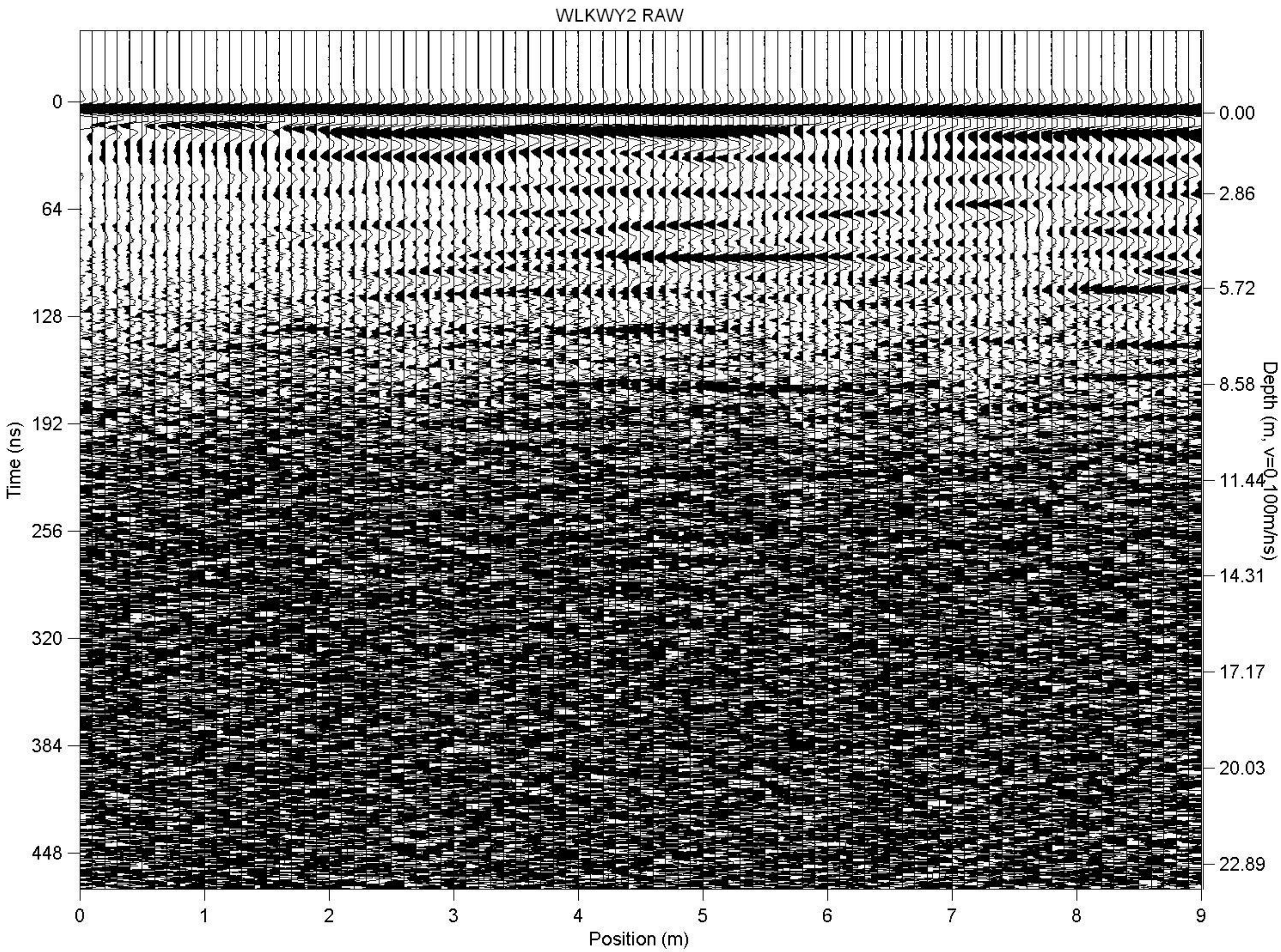
4
5
6
7
8
9


WLKWY2 RAW
Time (ns)
0
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
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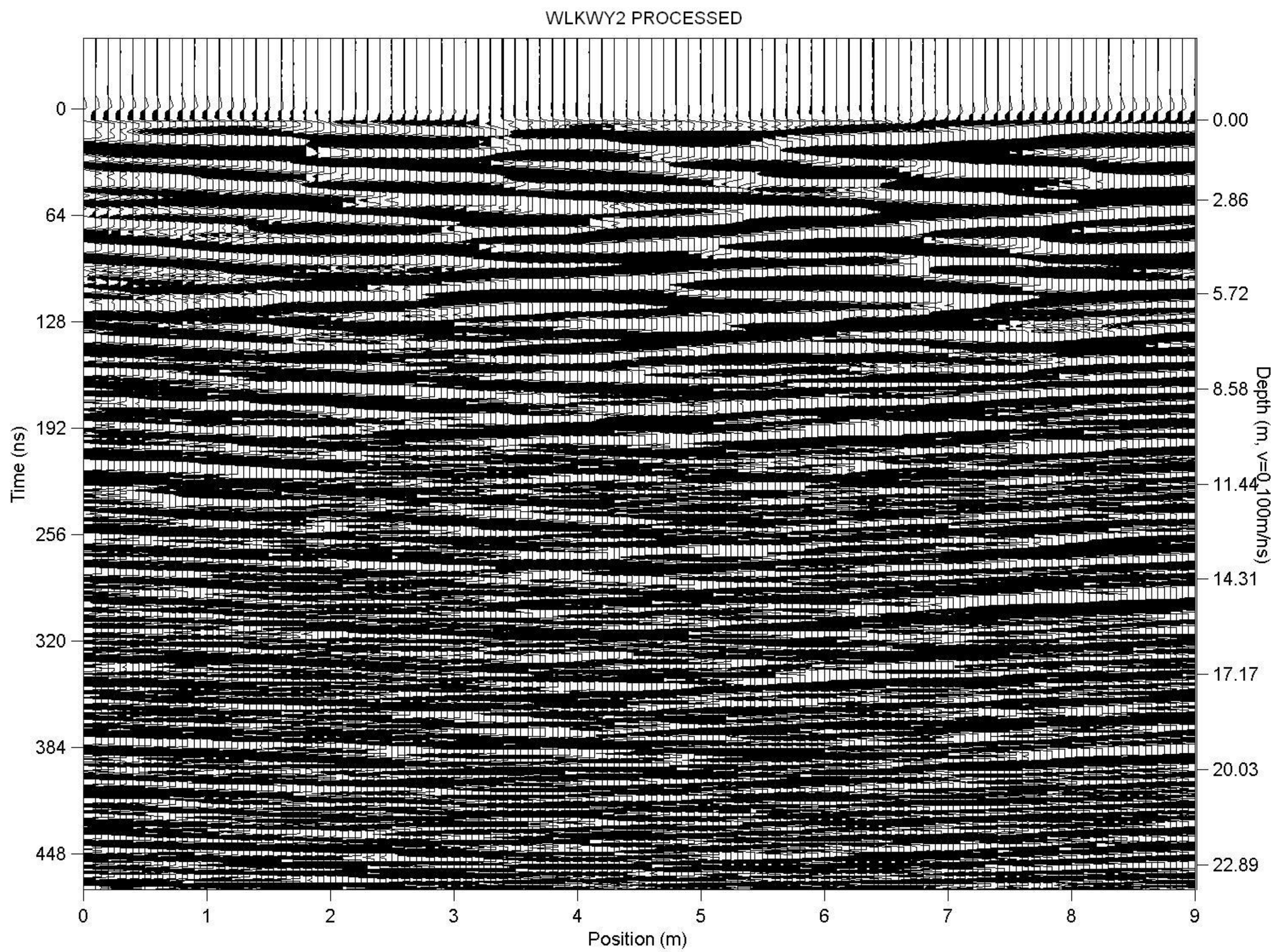
4
5
6
7
8
9


WLKWY2 PROCESSED
Time (ns)
0
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0
1
2
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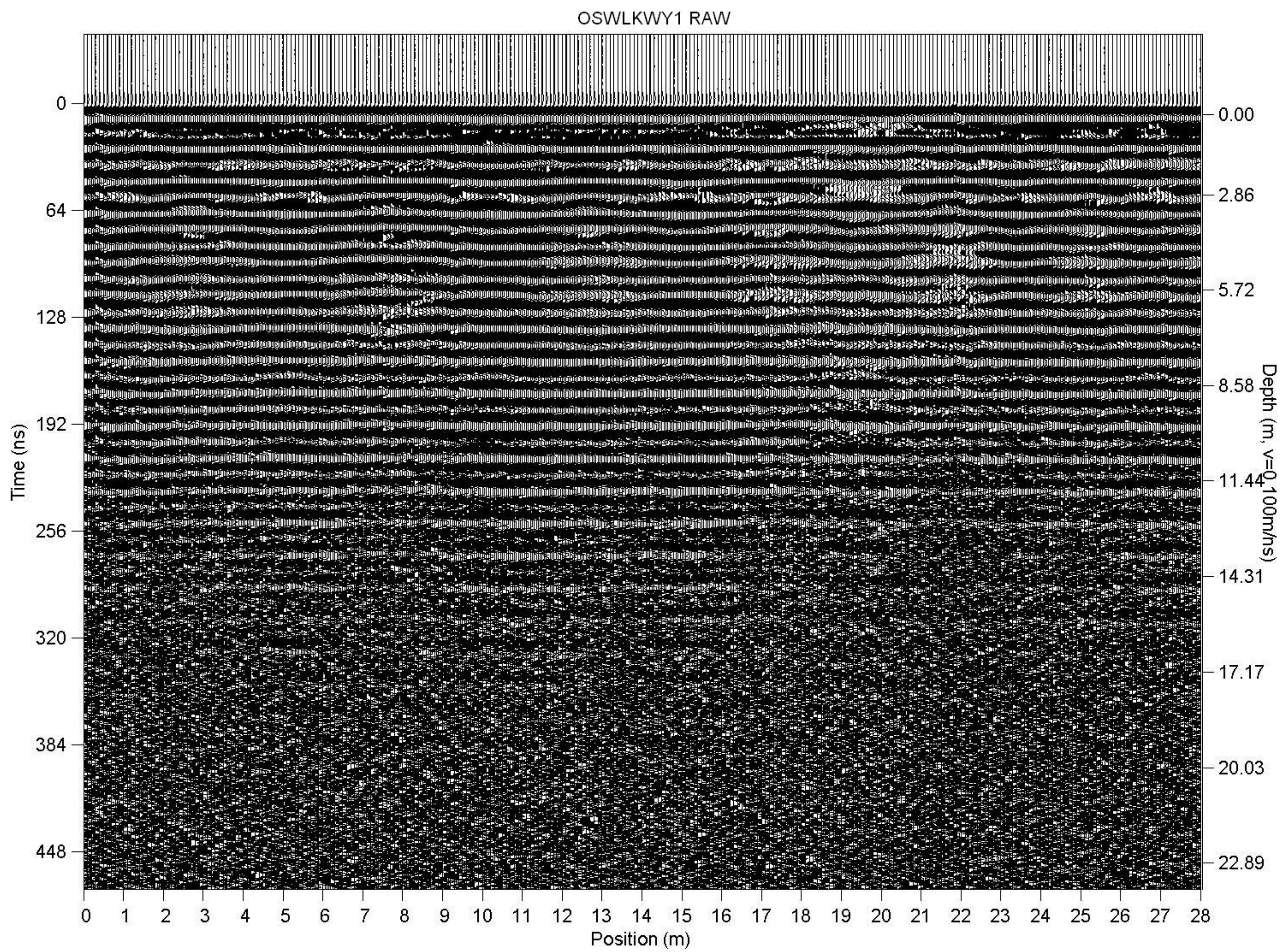
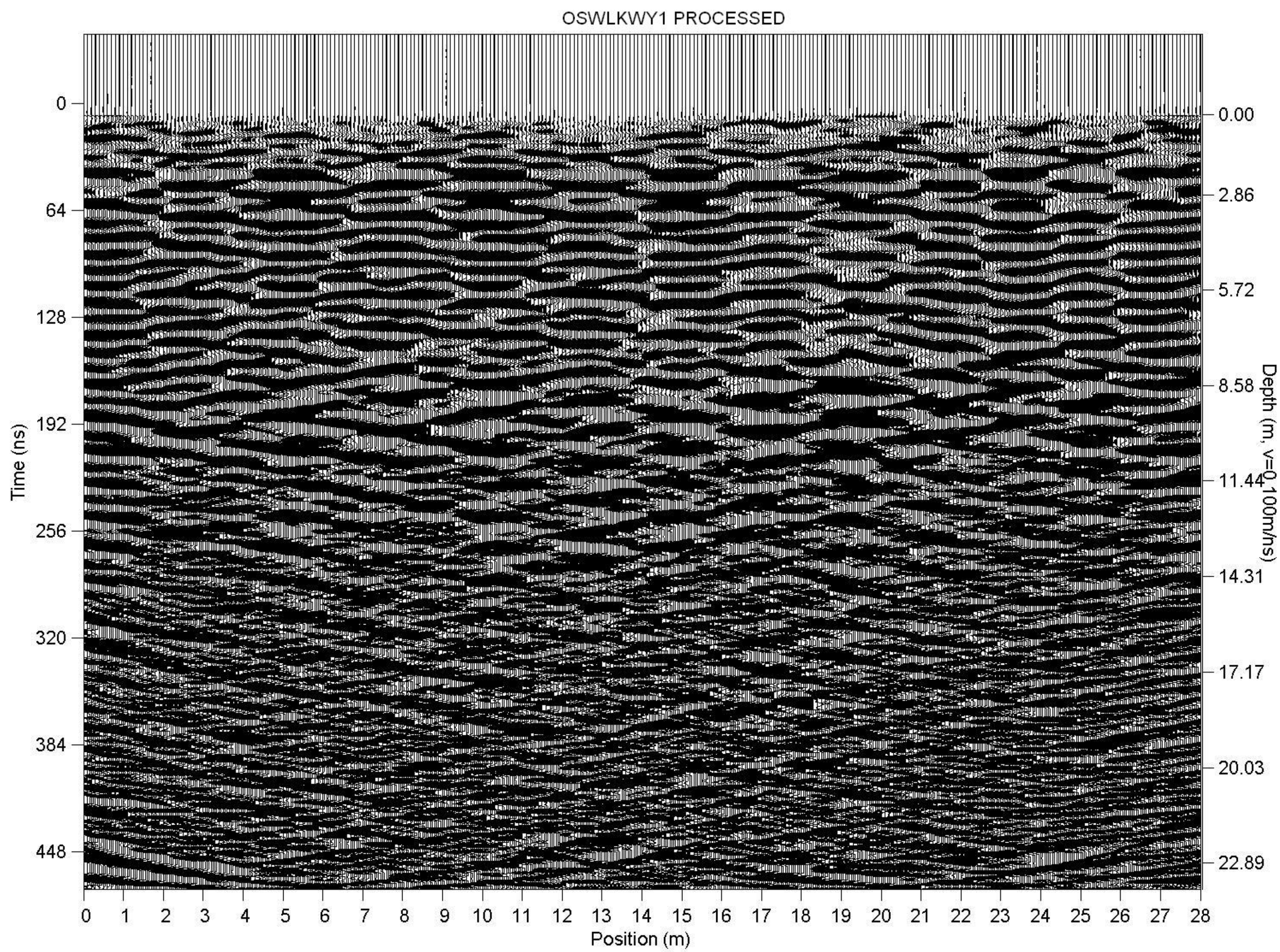
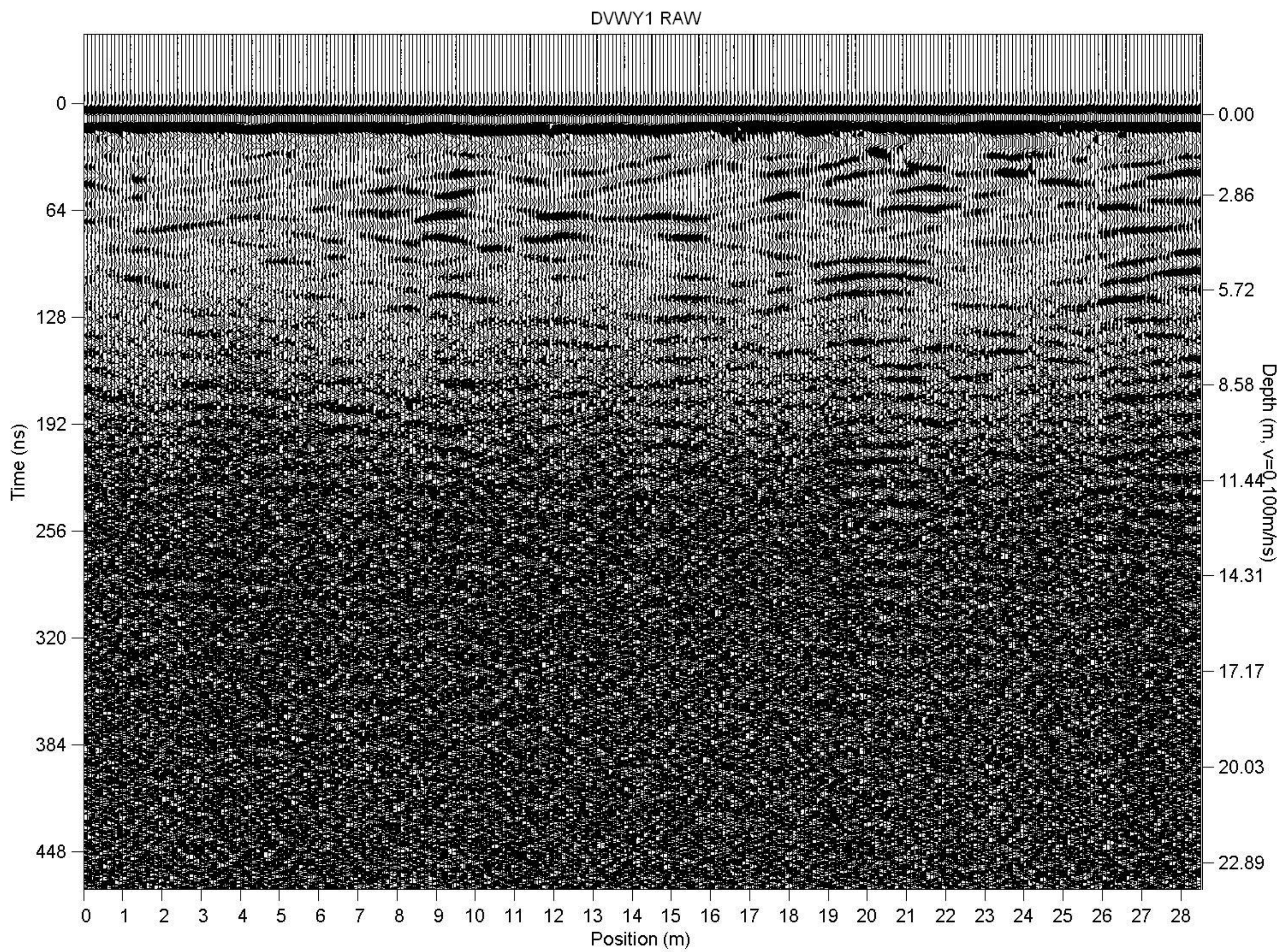
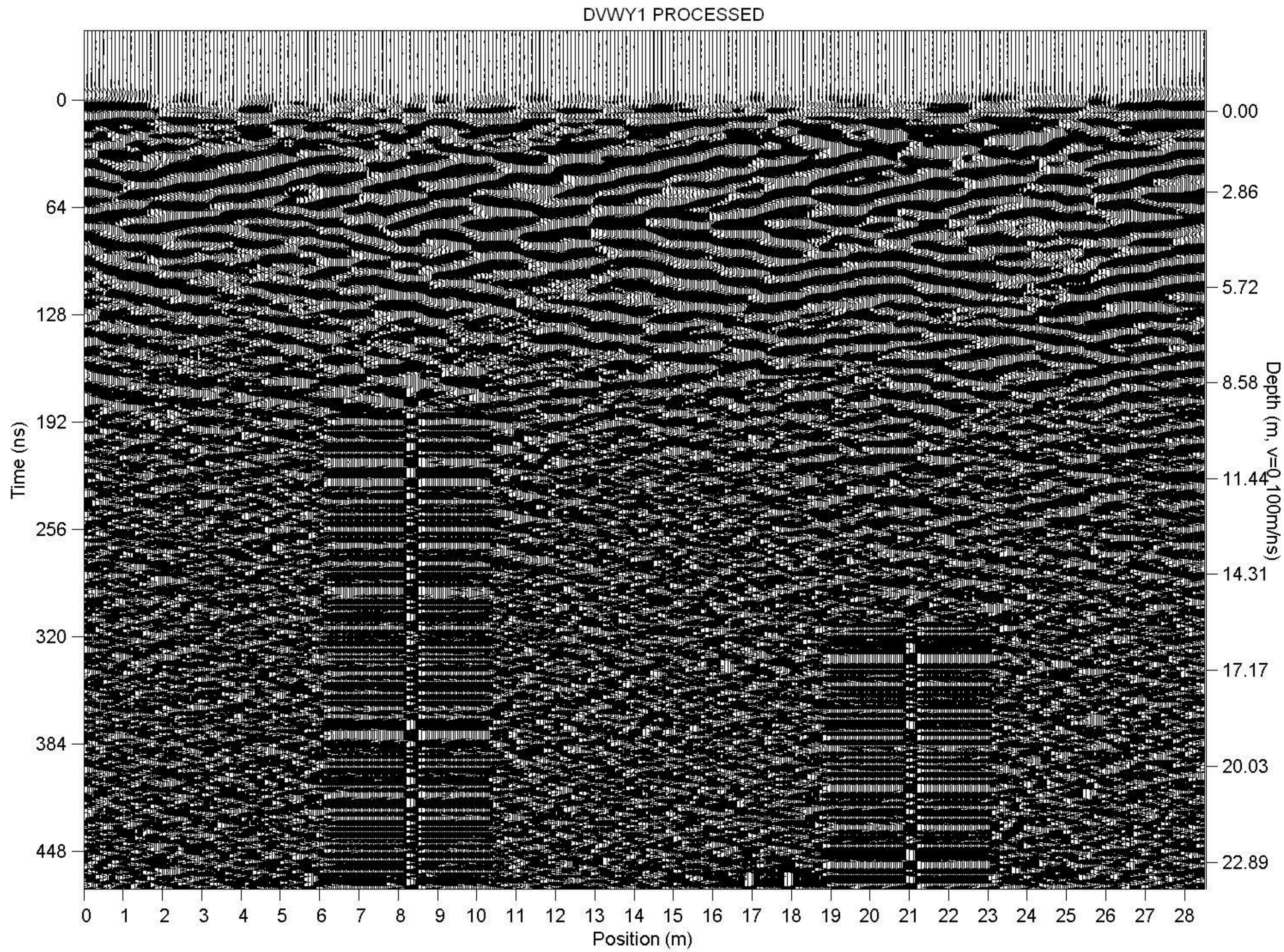
4
5
6
7
8
9


OSWLKWY1 RAW
Time (ns)
0
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28


OSWLKWY1 PROCESSED
Time (ns)
0
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28


DVWY1 RAW
Time (ns)
0
64
128
192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Position (m)


DVWY1 PROCESSED
Time (ns)
0
64
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192
256
320
384
448
Depth (m, v=0.100m/ns)
0.00
2.86
5.72
8.58
11.44
14.31
17.17
20.03
22.89
Position (m)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

APPENDIX C DETAILED DESCRIPTION OF DATA PROCESSES NOT USED

Air Wave Removal

When using the Excel Spreadsheet program and the AVGREMOVE.F program, the air wave is removed by using an average over several traces (a total of 3, 5, 7, 9, 11, and 41 traces were averaged). For example if the average is taken over 11 traces and the trace being looked at is number 21, traces 16 through 26 are averaged and then subtracted from the original value for trace 21 and the resultant is then put in place of the original value. According to Mr. Johnston with Sensoft, the Background Subtraction program should work in the same manner as discussed previously. However, there is an error in the program where instead for trace 21, traces 17 through 27 are averaged and then subtracted from the original value for trace 21 and the resultant is then put in place of the original. Two data comparison graphs were made to demonstrate the differences between each of these air wave removal programs, Figure C.1a and C.1b to compare the Excel Program to the Background Subtraction Program.

As observed in Figures C.1a and C.1b, there are minimal differences between the AVGREMOVE.F vs. the Background Subtraction Programs in the average amplitude spectrum plots when averaging 11 traces. When reviewing the Wiggle trace to compare the Raw Data (Figure 3.1a from Chapter 3) versus the AVGREMOVE.F air wave removal program (Figure C.2) and the Background Subtraction air wave removal program (Figure 3.1b from Chapter 3) using an average of 41 traces, the air wave was removed in both cases. During comparisons between the two techniques, averages were taken using 3, 9, 11, 21 and 41 traces. Using 41 traces appeared to be the best fit, especially when using Background Subtraction. The use of 41 traces allowed for the removal of the airwave without removing or averaging out the deeper reflectors observed in the raw data. Since the difference between AVGREMOVE.F vs. Background Subtraction Programs becomes smaller with an increase in the number of traces averaged, I continued to use the Sensoft Background Subtraction Program, as long as the number of traces chosen to be averaged over is not such a small number that certain deeper geologic features observed in the Raw Data are removed.

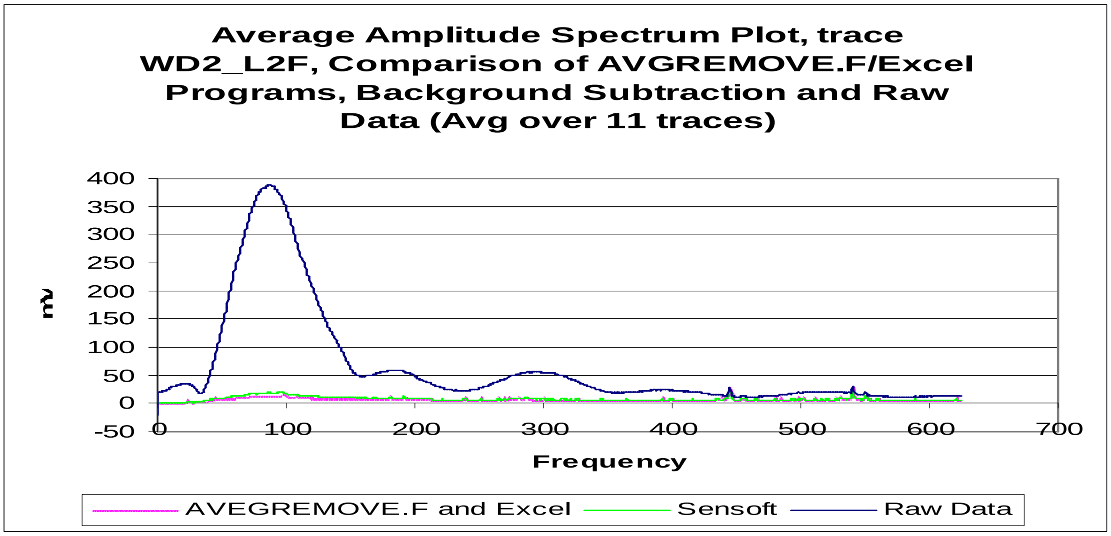

Figure C.1a. Compares the average amplitude spectrums, for Transect WD2_L2F, the processed data using the AVGREMOVE.F/Excel Programs to the Background Subtraction Program to the initial Raw Data.

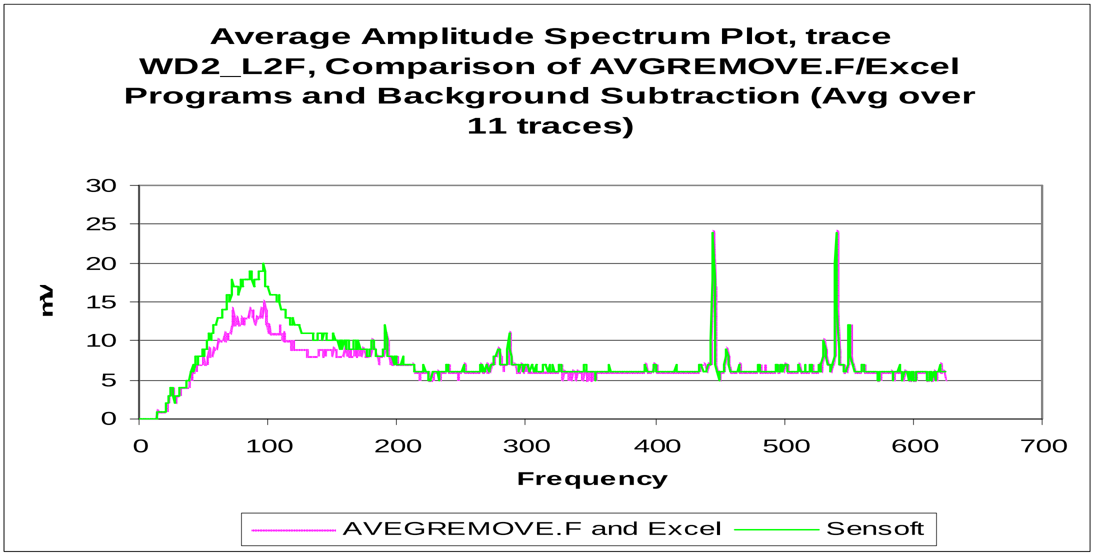

Figure C.1b. This figure is a zoomed in version of Figure 3.1a without the Raw Data.

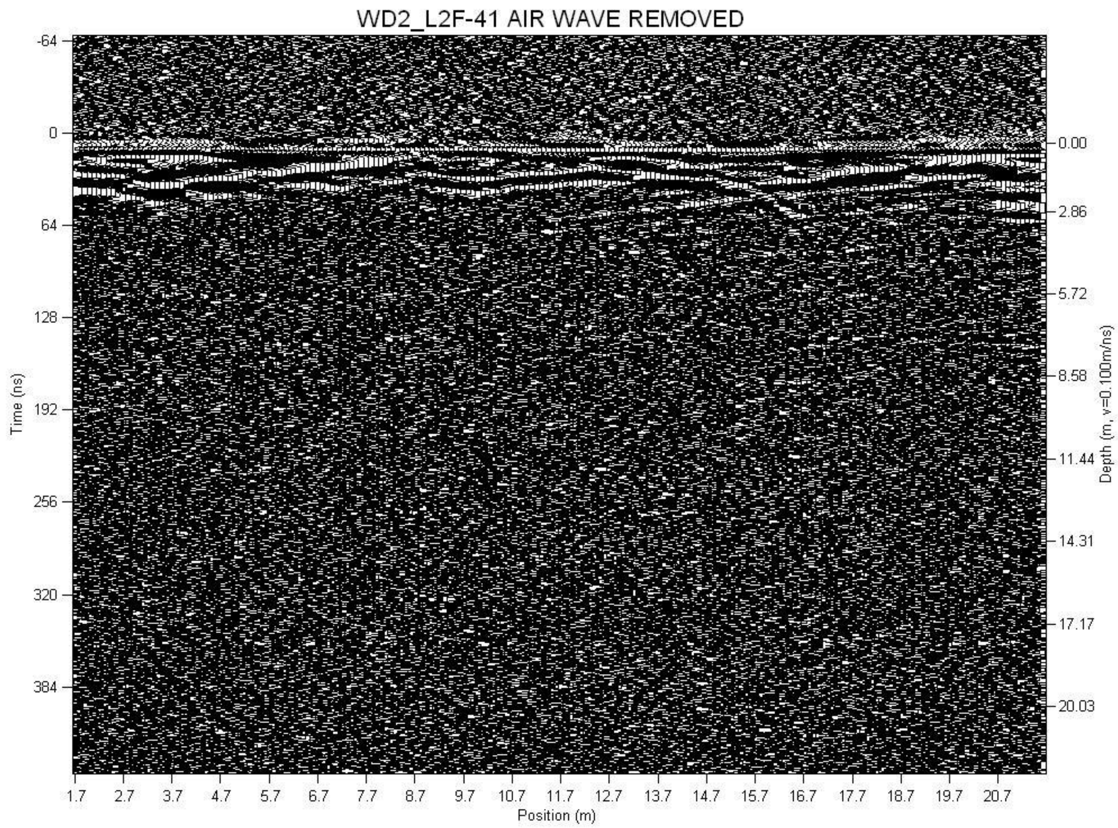

Figure C.2. Transect WD2_L2F after AVGREMOVE.F using 41 traces to average.

Gains

The additional gains available with the Sensoft computer package program; however, not used for final processing, included the following:

- Spreading and Exponential Compensation (SEC) which is an exponential gain function to try and compensate for attenuation of original signal due to spherical spreading,
- Constant Gain which multiplies all of the data by the same factor, during data acquisition this gain was used with a multiplier of 50, and
- AutoGain which uses an average decay of signal curve over time to gain the data.

There were positives and negatives for most of the processes. The SEC process was found to act similarly in nature to the AGC process when the default settings of attenuation equaling 1.0, the starting value equaling 1.0 and the gain max equaling 500 were used; however, with some minimal addition of signal noise to the raw data. The Constant Gain process, which was set up and used at a 50 multiplier for data acquisition, was also tested during data processing and was found to be significantly noisier when using a default multiplier of 50 in comparison to the raw data. The last process, AutoGain, is also found to be noisier then the raw data; however, not quite as severe as the Constant Gain process. The conclusion is that AGC is a the better gain choice when processing transects on bare ground, and no gain is better when processing transects through concrete/asphalt.

Time Filters

The additional time filtering methods available with the Sensoft computer package program; however, not used for final processing, included the following:

- Temporal Low Pass (TLP) Filter and Temporal High Pass (THP) filters combined to filter out low and high frequencies either below or above a certain percentage of the Nyquist frequency,
- Vertical which applies a running average filter down in time for each trace within the transect dataset. According to Sensoft, 2003, the reflected signal is averaged by replacing the original value at a given point in time by the average data value over a window centered about the original point. The more points/times used during the averaging process, more of the high

frequency noise will be removed. Its main purpose is to help reduce random or high frequency noise by acting as a TLP filter,

- Deconvolution which applies an inverse filtering affect. According to Sensoft, 2003, this process attempts to convert a radar wavelet into a spike. This filter uses the GPR centre frequency to restrict the wavelet estimation process.
- Temporal Median which applies a mean filter throughout time. According to Sensoft, 2003, the reflected signal is filtered by replacing the original value at a given point by the median data value over a window that is centered about the given point. Again this filter's primary purpose is to remove high frequency noise spikes, and

The TLP and THP Filters were combined to make a different kind of BandPass Filter in some data, which used in both cases 10% of the Nyquist Frequency. Initially when this filtering procedure was tested, combinations of different percentages were used for both the TLP and the THP such as 10, 20, 30, 50, 70, 80, and 90; however, the best response was from the 10% because data continuity was improved without smearing all the reflector responses. The final result from using the 10%, is a tendency to smooth the data or suppress dipping features and the filter tends to weaken as the time increases. However, this use of a 10% TLP and THP filter is not true to the data because it tends to create a notch filter. In which case if 10% of the Nyquist Frequency is an approximate value of 62.5MHz, then the TLP removes everything above this frequency and the THP removes everything below this frequency; therefore only allowing energy that comes in at this exact frequency value. In other instances only the High Pass Filter was tested, and again with a 10% of the Nyquist Frequency chosen, which tended to filter out the lower frequency data without creating a lot of noise, and made the reflectors more coherent. However, the use of these two filters either together or separately were not as effective as using the combined continuous feature of a BandPass filter that takes both into consideration.

The Vertical filter was tested with a default value of 3. For example, times 9, 10, and 11 were averaged and then put in place of the original value for time 10. According to Sensoft, its main purpose is to reduce random or high frequency noise by acting as a low pass temporal filter (TLP). This filter smoothes out the noise especially at shallow depths; however, it is less effective then the BandPass filter or the combination TLP/THP filters. Since this process was less effective, it was not used for the complete data set.

When the Deconvolution filter was chosen, the defaults of 100MHz for frequency, 3ns for filter width, 15ns for delay, 3ns for spike width, and 0.05 for whitening were used. This process tends to filter out all the data so that no signal is viewed when Ekko_View is used to view the section. According to Sensoft, 2003, this filtering process is supposed to convert a radar wavelet into a spike; however, this affect was not observed when using the default values for the process. As a result this process was not chosen to be used for final processing.

When using the Temporal Median Filter which applies the filter going vertically (time) down the trace, similar to the Vertical Filter. According to Sensoft, 2003, the reflected signal is filtered by replacing the original value at a given point by the median data value of points from adjacent times in a window centered about the given point. For example for time 10, using a filter width of 3 and mean points of 1, the time values for 9, 10 and 11 (filter width) are rearranged in ascending order of magnitude, then the new value for 10 (mean point) is taken and plugged in for the original time 10 value. When testing out this process using the default settings of 3 for window width and 1 for mean value, the process tends to smooth out the data but results are noisier then the BandPass filter; therefore, it was not chosen for final processing of data.

The BandPass filter was the time filter chosen for processing. The reasons for choosing the BandPass filter were that it both enhanced deeper reflectors, and increased continuity of some reflectors at both deep and shallow depths. This process filters out both low frequency, and high frequency noise.

Spatial Filters

The additional spatial filtering methods available with the Sensoft computer package program; however, not used for final processing, included the following:

- Trace Difference, which works similarly to the Background Subtraction process; however, in this case it subtracts each trace from the previous trace, as opposed to being able to specify how many traces to use and average;
- Median Filter, which according to Sensoft filters out single bad traces from the data;
- Spatial Low Pass Filter (SLP) and Spatial High Pass (SHP) Filters which work in the same way as the TLP and THP filters, this process is supposed to remove dipping events while enhancing horizontal events; and,
- Binomial Filter which works similarly to the Horizontal Filter.

The Trace Difference process was tested and works very similar to Background Subtraction. However, in the case of Trace Difference there is no averaging of several traces, instead each original trace is averaged with the preceding trace and that average is subtracted from the original. For example when the original trace is #3, then the average is taken using #2 and #3, then the average is subtracted from the original value for #3, and the resultant value is the new value for #3. No inputs are required for this process, and it essentially acts like a severe Spatial High Pass Filter. Using this process tends to make the data much noisier then the original or already processed data with THP or BandPass time filters. Because this process makes the data noisier, and because the Background Subtraction process has already been employed to remove the air wave, this process was not used further.

The Spatial Median process was tested, which works very similar to the Time Median process. However, the Spatial Median process works by taking the average horizontally, distance/spatially. According to Sensoft, 2003, the reflected signal is filtered by replacing the original value at a given point by the median data value of points from adjacent traces in a window centered about the given point. For example for point 10, using a filter width of 3 and mean points of 1, the values of 9, 10, and 11 (filter width) are rearranged in ascending order of magnitude, then the new value for 10 (mean point) is taken and plugged in for the original point 10 value. When testing out this process, values of 3 and 11 were used for the window width, and values of 1 and 3 were used for the mean value respectively. Using this process with settings of 3, and 1, tends to smooth out the data; however, when using settings of 11 and 3, all of the data signal response seems to be smeared. Even though the use of this process tends to smooth out some of the noisier areas of the data when tested on the raw data, because the Background Subtraction process has already been used, this process will not be used because it does not add to the coherence of the data.

The SLP and SHP processes were tested, which work very similar to the TLP and THP; except this filtering is done in the distance domain. Instead of filtering vertically through time, these filter horizontally through distance. Multiple Nyquist frequency percentages were tested out; such as, 10, 20, 40, 50, and 60. The best percentages were found to be 10 for both SLP and SHP, as the percentage was increased the data signal response seemed to be completely removed. When using 10% for both SLP and SHP, the signal data in the shallow depths tends to be more coherent, and to some degree the deeper reflectors have the same effect. The final result from using the 10%, is a tendency to smooth the data or suppress dipping features. However, as in the case of the TLP/THP, this use of a 10% SLP/SHP filter is not true to the data because it tends to create a notch filter. Therefore, everything above and below the 10% Nyquist frequency is removed only leaving the 10% value to remain. Again because the Background Subtraction and BandPass have already been chosen to be used on the remaining data, this process was not used.

The Binomial process was also tested, which according to Sensoft, differs from the Horizontal process because the filter width is tapered at the ends. The Binomial process also emphasizes flat lying or slowly dipping reflectors. For example, when using the default setting of 3, the original trace value is replaced with a weighted average trace and the traces in the center are weighted more than at the ends during the averaging calculation. This process is similar to the Horizontal filter, but the Horizontal filter is more efficient. Thus, this process is not used further.

Both the Background Subtraction and Horizontal spatial filters were chosen for processing. Background Subtraction was chosen as the most affective way to remove the air wave, without loosing any deeper reflectors. The Horizontal process was chosen to be used, with a value of 3 in order to help amplify or resolve the deeper signal response and to assist in making the shallower reflectors more coherent.

2D Filters

The additional 2D filtering method available with the Sensoft computer package program; however, not used for final processing, was the Dip Filter. The Dip Filter according to Sensoft (2003) applies a binomial spatial differencing filter at a particular dip angle that is entered. The Dip Filter process according to Sensoft (2003) is used to enhance at a certain dip angle. The parameters that are required prior to the use of this processing were the Dip Slope, Filter Width, and Scale. The default settings were for a Dip Slope of 0, a Filter Width of 3, and a Scale of 1.0. Using the defaults tended to remove all of the deeper reflectors, and make the shallower reflectors noisier. Dip slopes of 10 and 30 were also tested. When using a dip slope of 10, most of the signal and coherence in data gained from processing up to this point is lost. When using a dip slope of 30, most of the processing up to this point is maintained; however, there is no additional improvement in the overall data. The maximum dip slope allowed for this process was 30; therefore, no higher slopes could be tested. Because of these results, this process was not chosen to be used further.

The Migration filter was chosen for processing. This process was chosen to be used for all data sets that require a 2D migration because it tends to make the data more coherent.

APPENDIX D DETAILS ON VERTICAL DIFFERENCING DATA RESEARCH

During the course of tracking down Geodetic Leveling data for multiple years, I contacted multiple agencies/institutions including the USGS Earth Science Information Center (USGS ESIC), USGS Coastal and Marine Geology program for Southeastern Louisiana (USGS CMG), NOAA/NGS, LSU Department of Civil Engineering, particularly the Center for Geoinformatics, and the Army Corps of Engineers in New Orleans, LA. Initially I spoke with Mr. Robert Kimmel with the USGS ESIC who in turn referred me to the USGS CMG. According to the USGS CMG website, http://coastal.er.usgs.gov/LA-subsidence/, they focus their studies on subsidence as it pertains to sea level rise/fall. I then contacted Juliana Blackwell who is the Height Modernization Program Manager for NOAA/NGS who had the information I needed but referred me back to the LSU Department of Civil Engineering,, in particular Dr. Roy Dokka, who she had already supplied with this same information. Dr. Dokka refused to provide the needed information and referred me to an unspecified, future publication of his research results, as seen in the following excerpt from a personal e-mailed communication received from Dr. Dokka in October 2004:

> "Ms. Thomas. Your inquiry touches upon my personal research focus in structural geology. Following reduction of geodetic data from the NGS database, I have combined resultant vertical velocities with fault geometric and kinematic data and computed slip rates for all faults in central Louisiana as well as most other faults. These are all referenced to NAVD88. We have and continue to monitor yearly changes in fault motions on the faults you mention as well as others by 1st order geodetic leveling. These results are in review and hopefully be published and available to you in the near future. A word of warning—Changes in published elevations over time DO NOT reflect meaningful rates. Published elevations are artifacts of a process called an 'adjustment'. This is a statistical exercise that geodesists use to distribute errors in a network. In effect, all vertical observations in a network are nudged a bit to fit a simple yet arbitrary regression surface. Note that all published elevation shave no errors associated with them."

My next course of action was to contact Mr. Gilbert Mitchell with NOAA/NGS who referred me to an employee of his, Mr. Kurt Shinkle. My initial dealings with Mr. Shinkle were that his areas of data were too far west. However, he referred me to Mr. Cliff Mugnier who is an LSU adjunct instructor in the Department of Civil Engineering.

Mr. Mugnier was able to assist me in locating and reviewing the historical years of vertical and horizontal geodetic data available at the Army Corps of Engineers in New Orleans. Also, Mr. Mugnier referred me to a Master's Thesis completed by Araya Kebede in 2004 entitled 'Movement Along the Baton Rouge Fault', which looks at a few benchmarks and how they vary in elevation across the Baton Rouge Fault during his study in 2004 versus what he obtained from the NOAA/NGS website Data Sheets.

In reviewing the Data Sheets and map of surveyed areas provided on the NOAA/NGS website, http://www.ngs.noaa.gov/products_services.shtml#DataSheets, I found that these data sheets provide the most recent adjusted vertical elevation data, however with no reference to when the initial measurement was collected. Because of this, I again consulted with both Mr. Mugnier and Mr. Shinkle to inquire about what the adjustments were and why they were made, and how to track down the initial vertical elevation measurements prior to adjustments. According to Mr. Mugnier, these vertical elevation data are relative rather than absolute because they have been adjusted to some datum which has varied throughout the history of Geodetic Vertical Leveling. According to the history of Geodetic Vertical Datums, found in Zilkowski et al 1992, the history of datums began in 1887 with a benchmark in Hagerstown Maryland. Subsequent readjustments of the level line network were completed by the government agency Coast and Geodetic Survey (C&GS) in 1903, 1907, and 1912 (Berry 1976). The next major readjustment of vertical datum was completed in 1929, known as the National Geodetic Vertical

Datum (NGVD29), which constrained the heights of 26 coastal tidal stations which acted as the vertical datum. The most recent adjustment is the North American Vertical Datum 1988 (NAVD88), which refers to the MSL at Father Point/Rimouski, located at the mouth of the St. Lawrence River. Of the literature that was reviewed, I concentrated on the comparisons of discrepancies between NGVD29 and NAVD88 as all my data would have been influenced by one or both of these datums. In general, the overall vertical height difference between the NAVD88 and NGVD29 datums range from -40cm to +150cm (Zilkowski et al, 1992). This means that in comparing these two datums sometimes there is a deficiency of -40cm (benchmark elevation is down in comparison to the NGVD29 elevation) and in some cases there is an excess of +150cm (benchmark elevation is up in comparison to the NAVD88 elevation) when comparing individual benchmark vertical elevation data. This difference range between the NGVD29 datum and the NAVD88 datum is due to a combination of error in the data and true movement of the earth's surface. Also, according to Zilkowski et al data, adjustment from the NGVD29 to the NAVD88 datum took longer to complete in some areas due to larger crustal movement; such as in southern Louisiana and Houston.

Because of this I went back to Mr. Shinkle to see if he could provide me any better/more accurate data. After multiple phone conversations and e-mail communications, Mr. Shinkle was able to provide me with 3 initial deliverables, which have been described in detail in Chapter 4. Table D.1 shows the data provided to the NGS, and the data they provided for the first 2 deliverables. Tables D.2 through D.4 show the data provided by the NGS for each of the NMOs in regards to the Level Line Projects for L24133/16, L24133/17, and L24804/1 respectively.

Table D.1 Data Submitted to and First 2 Deliverables Acquired from the NGS					
NGS Website Map BM Number	PID Number	Line Project	Level Accuracy	Class Accuracy	Designation by Surveyor
190	AC8261	N/A	N/A	N/A	N/A
359	AI3123	N/A	N/A	N/A	N/A
494	BJ0862	L20214	1	2	T216
		L24133/16	1	1	T216
		L24133/17	1	1	T216
		L25082/17	2	2	T216
		L25082/18	2	2	T 216
		L25082/23	2	2	T 216
506	BJ0863	L20214	1	2	U 216
		L24133/16	1	1	U 216
		L25082/18	2	2	U 216
509	BJ0864	L20214	1	2	V 216
		L24133/16	1	1	V 216
381	BJ0865	L24133/16	1	1	G 287
		L25082/18	2	2	G 287
467	BJ0875	L24133/16	1	1	Q 286
		L24813	2	1	Q 286
		L25082/29	N/REQ	N/REQ	Q 286
512	BJ0950	L20214	1	2	W 216
20	BJ0987	L24133/17	1	1	17
		L25082/23	2	2	17
47	BJ3370	L24804/1	2	1	17 V 39 1983 LADH
499	BJ3373	L24804/1	2	1	Taylor RM 2
		L25082/12	2	2	Taylor RM 2
49	BJ3374	L24804/1	2	1	17 V 40
		L25082/12	2	2	17 V 40
		L25082/13	N/REQ	N/REQ	17 V 40
50	BJ3375	L24804/1	2	1	17 V 41
		L25082/12	2	2	17 V 41
52	BJ3380	L24804/1	2	1	17 V 43
		L25082/12	2	2	17 V 43
492	BJ3760	L24813	2	1	Stevens RM 2
394	BJ3768	L24813	2	1	Hare
		L25082/25	N/REQ	N/REQ	Hare
		L25082/26	N/REQ	N/REQ	Hare
		L25082/27	N/REQ	N/REQ	Hare
32	BJ3770	L24813	2	1	17 C 002
		L25082/27	N/REQ	N/REQ	17 C 002

Table D.1 (Cont.)					
NGS Website Map BM Number	PID Number	Line Project	Level Accuracy	Class Accuracy	Designation by Surveyor
30	BJ3771	L24813	2	1	17 C 001
416	BJ3773	L24813	2	1	Lane
420	BJ3774	L24813	2	1	Lane RM 2
214	BJ3904	L25082/32	N/REQ	N/REQ	8 87
212	BJ3906	L25082/28	N/REQ	N/REQ	7 87
209	BJ3907	L25082/27	N/REQ	N/REQ	6 87
		L25082/28	N/REQ	N/REQ	6 87
159	BJ3909	L25082/25	N/REQ	N/REQ	3 87
115	BJ3910	L25082/25	N/REQ	N/REQ	2 87
		L25082/33	N/REQ	N/REQ	2 87
3	BJ3911	L25082/25	N/REQ	N/REQ	1 87
		L25082/34	N/REQ	N/REQ	1 87
185	BJ3913	L25082/12	2	2	41 87
179	BJ3915	L25082/12	2	2	40 87
430	BJ3916	L25082/18	2	2	Monterrey
170	BJ3917	L25082/15	N/REQ	N/REQ	34 87
216	BJ3926	L25082/32	N/REQ	N/REQ	9 87
437	BJ3927	L25082/27	N/REQ	N/REQ	Nesser
		L25082/31	N/REQ	N/REQ	Nesser
		L25082/32	N/REQ	N/REQ	Nesser
327	BJ3930	L25082/29	N/REQ	N/REQ	Clay Cut
137	BJ3931	L25082/29	N/REQ	N/REQ	224 73
136	BJ3932	L25082/29	N/REQ	N/REQ	223 73
178	BJ3940	L25082/25	N/REQ	N/REQ	4 87
192	BJ3942	L25082/20	N/REQ	N/REQ	448
8	BJ3949	L25082/32	N/REQ	N/REQ	118 59
119	BJ3955	L25082/32	N/REQ	N/REQ	204 73
		L25082/33	N/REQ	N/REQ	204 73
204	BJ3975	L25082/12	2	2	523
		L25082/16	N/REQ	N/REQ	523
218	BJ3990	L25082/24	N/REQ	N/REQ	909
237	BJ3995	L25082/14	N/REQ	N/REQ	A 919
		L25082/18	2	2	A 919
402	BJ3996	L25082/18	2	2	Joyce
228	BJ3998	L25082/14	N/REQ	N/REQ	979 Reset
		L25082/20	N/REQ	N/REQ	979 Reset
316	BJ4013	L25082/12	2	2	C 922 Reset
207	BJ4040	L25082/30	N/REQ	N/REQ	58 73

Table D.1 (Cont.)					
NGS Website Map BM Number	PID Number	Line Project	Level Accuracy	Class Accuracy	Designation by Surveyor
207	BJ4040	L25082/31	N/REQ	N/REQ	58 73
211	BJ4042	L25082/30	N/REQ	N/REQ	61 73
210	BJ4043	L25082/30	N/REQ	N/REQ	60 73
125	BJ4046	L25082/29	N/REQ	N/REQ	212 73
		L25082/30	N/REQ	N/REQ	212 73
134	BJ4047	L25082/27	N/REQ	N/REQ	220 73
520	BJ4062	L25082/18	2	2	West Rail
157	BJ4064	L25082/17	2	2	28 87
158	BJ4065	L25082/17	2	2	29 87
161	BJ4066	L25082/17	2	2	30 87
152	BJ4069	L25082/14	N/REQ	N/REQ	25 87
187	BJ4074	L25082/13	N/REQ	N/REQ	412
153	BJ4077	L25082/18	2	2	26 87
176	BJ4078	L25082/13	N/REQ	N/REQ	39 87
188	BJ4084	L25082/10	N/REQ	N/REQ	414
184	BJ4088	L25082/13	N/REQ	N/REQ	409
		L25082/18	2	2	409
121	BJ4090	L25082/28	N/REQ	N/REQ	209 73
		L25082/30	N/REQ	N/REQ	209 73
		L25082/31	N/REQ	N/REQ	209 73
118	BJ4093	L25082/31	N/REQ	N/REQ	202 73
205	BJ4094	L25082/31	N/REQ	N/REQ	55 73
126	BJ4095	L25082/29	N/REQ	N/REQ	213 73
124	BJ4096	L25082/29	N/REQ	N/REQ	211 73
123	BJ4097	L25082/29	N/REQ	N/REQ	210
		L25082/30	N/REQ	N/REQ	210
129	BJ4098	L25082/29	N/REQ	N/REQ	217 73
130	BJ4099	L25082/29	N/REQ	N/REQ	218 73
131	BJ4100	L25082/29	N/REQ	N/REQ	219 73
171	BJ4103	L25082/29	N/REQ	N/REQ	35 87
42	BJ4108	L25082/31	N/REQ	N/REQ	17 Q 013
39	BJ4109	L25082/25	N/REQ	N/REQ	17 G 001
329	BJ4922	N/A	N/A	N/A	N/A
519	BJ4940	N/A	N/A	N/A	N/A
95	BJ4952	N/A	N/A	N/A	N/A
388	BJ4986	N/A	N/A	N/A	N/A
387	BJ4988	N/A	N/A	N/A	N/A
504	BJ5079	N/A	N/A	N/A	N/A

Table D.1 (Cont.)					
NGS Website Map BM Number	PID Number	Line Project	Level Accuracy	Class Accuracy	Designation by Surveyor
419	BJ5329	N/A	N/A	N/A	N/A

Notes: N/A = Not Applicable, not in Level Line Project
N/REQ = Not Requested, BM not included in correlative Level Line Projects

Table D.2 3rd Deliverable Acquired from the NGS, NMO for L24133/16, yr 1976			
Designation	**Distance from L24133/16 (km)**	**LL Comparison (L24813, yr 1984) (mm)**	**LL Comparison (L1498, yr 1934) (mm)**
E22	12.65		0
Stevens RESET	20.86	0	
Stevens RM 3	20.87	29.81	
Q 286	21.07	26.69	
M 286	23.57	17.66	
B 22	25.83		-114.85
TT 7 L USGS	29.69		-135.35
T 286	35.34	8.26	
TT 9 L USGS	41.08		-168.21
Y 21	44.22		-162.47
S 294	46.33	-4.46	
T 294	53.8	-5.97	
TT 13 L	62	-10.62	-135.69
U 21	64.44		-133.93
TT 14 L USGS	66.86		-154.22
G 295	68.09	-6.83	
F 295	69.38	-11.17	
E 295	69.8	-26.86	

Notes: Each LL has BM's in common with baseline, LL24133/16
The first common BM is considered equivalent to elevation of the baseline, LL24133/16
Therefore the difference would be 0.00. Each subsequent common BM is the difference in elevation from the first common BM, minus the equivalent difference on the baseline, L24133/16 in mm

TABLE D.3 3rd Deliverable Acquired from the NGS, NMO L24133/17, yr 1977				
Designation	Dist. from L24133/17 (km)	LL Comparison (L24970, yr 1986) (mm)	LL Comparison (L19631, yr 1964) (mm)	LL Comparison (L8069, yr 1938) (mm)
J 22	0.22	0		
L 22	1.47		0	0
17 B 013	1.73	20.83		
C 204	2.14	-42.36		
B 197 WELL	2.75		-3.98	
2	2.84		9.19	-9.86
XXXI	3.01		-3.14	-34.92
NORTH BOULEVARD CAP	3.17		22.3	-22.25
POST OFFICE	3.2		7.16	-24.06
K 22	2.95		2.2	-28.83
M 197	3.95		-1.94	
N 197	4.35		1.47	
P 197	4.87		-1.98	
Q 197	6.23		-2.02	
R 197 WELL	7.96		-12.17	
W 197	8.79		-11.79	
U 197	11.17		-16.38	
V 197	11.27		-10.54	
J 288	3.76	-5.56		
C 198	5.2		-15.43	
K 288	4.53	-26.6		
D 197	5.42	-21.89	10.34	
C 927 LAGS	6.7		-8.71	
C 929	8.08	-23.52	-32.35	
C 930	8.63	-14.52	-33.64	
ARLINGTON CAP RESET	8.67	-19.64	-23.59	
B 198	10.05	-13.4	-45.76	
W 94 RESET	11.71	-8.31	-37.78	
C 936	13.04	-77.76	-33.43	
XXV11	14.37		-16.52	-128.27
C 940	15.11		-17.74	
E 197	16.07	-10.93	-15.83	
C 944	17.63		-6.6	
L 197 RESET	19.35	-20.17		
K 197 RESET	20.8	-35.14		

Notes: Each LL has BM's in common with baseline, LL24133/17. The first common BM is considered equivalent to elevation of baseline.Therefore the difference is 0.00. Each subsequent common BM is the difference in elevation from the first common BM,minus the equivalent difference on baseline in mm.

TABLE D.4 3rd Deliverable Acquired from the NGS, NMO for L24804/1, yr 1983		
Designation	**Distance from L24804/1 (km)**	**LL Comparison (L25082/12, yr 1987) (mm)**
TAYLOR	4.1	0
TAYLOR RM 2	4.11	0.6
17 V 40	5.7	-17.24
17 V 41	7.65	-25.31
17 V 42	8.71	-25.63
BOLO 3	10.09	-27.38
BOLO 3 RM 5	10.14	-23.14
17 V 43	11.89	-18.57
17 V 44	13.66	-19.02
17 V 45	15.19	-18.7
SULLIVAN RM 2	16.11	-9.43
SULLIVAN	16.15	-9.56

Notes: Each LL has BM's in common with baseline, LL24804/1
The first common BM is considered equivalent to elevation of the baseline, LL24804/1
Therefore the difference would be 0.00. Each subsequent common BM is the difference in elevation from the first common BM, minus the equivalent difference on the baseline, L24804/1 in mm

```
                 HGZ = L24133/16       ORDER CLASS = 11
NEW ORLEANS DISTRICT CORPS OF ENGINEERS LEVELING
BATON ROUGE TO HAMMOND LA
Leveling from 09/16/76 to 10/29/76
Agency = NGS      First three states = LA

 SPSN  ACRN  DESIGNATION              SP

@1002 BJ0555 Q 287                         L24133/10     L24133/16
L24133/17     L24133/9      L25082/21
@0570 BJ0858 C 287                         L24133/16     L24962/1      L24970
@0571 BJ0859 D 287                         L24133/16     L24962/1      L24970
L25082/17     L25082/21
@0572 BJ0860 E 287                         L24133/16     L25082/17
@0573 BJ0861 F 287                         L24133/16     L25082/17
@0574 BJ0862 T 216                         L20214        L24133/16
L24133/17     L25082/17     L25082/18     L25082/23

 7025 AK8410 TBM 7025                      L24133/16
@0575 BJ0863 U 216                         L20214        L24133/16
L25082/18
@0576 BJ0864 V 216                         L20214        L24133/16
@0577 BJ0865 G 287                         L24133/16     L25082/18
 7024 AK8411 TBM 7024                      L24133/16
@0578 BJ0866 E 22                          L1498         L20214
L24133/16     L25082/18     L25082/19     L25082/20
                                           L25082/26
@0579 BJ0867 X 216                         L20214        L24133/16
L25082/19
@0580 BJ0868 R 287                         L24133/16     L25082/19
@0581 BJ0869 S 286                         L24133/16     L25082/19
L25082/22
@0582 BJ0870 17 K 004                      L24133/16     L25082/19
@0583 BJ0871 R 286                         L24133/16     L25082/19
@0584 BJ0872 17 K 006                      L24133/16     L25082/19
L25082/29
@0585 BJ0873 STEVENS RESET                 L24133/16     L24813
@0586 BJ0874 STEVENS RM 3                  L24133/16     L24813
@0587 BJ0875 Q 286                         L24133/16     L24813
L25082/29
 7023 AK8412 TBM 7023                      L24133/16
@0588 BJ0876 P 286                         L24133/16
@0589 BJ0877 M 286                         L24133/16     L24813
@0590 BJ0878 N 286                         L24133/16
@0591 BJ0879 P 294                         L24133/16
@0592 BJ0880 B 22                   ( 1)   L1498         L24133/16
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*******************************************************
@0593 BJ0881 X 287                         L24133/16
@0594 BJ0882 Y 287                         L24133/16
@0595 BJ0883 TT 7 L USGS                   L1498         L24133/16
@0596 BJ0884 Z 287                         L24133/16
@0597 BJ0885 L 286                         L24133/16
@0598 BJ0886 Q 294                         L24133/16
@0599 BJ0887 W 286                         L24133/16
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@0642 BJ0888 T 286                          L24133/16     L24813
@0643 BJ0889 U 286                          L24133/16
@0644 BJ0890 V 286                          L24133/16
@0645 BJ0891 X 286                          L24133/16
@0646 BJ0892 Y 286                          L24133/16

@ = navd 88 adjusted mark
M = navd 88 crustal motion height

 SPSN  ACRN  DESIGNATION               SP

@0647 BJ0893 TT 9 L USGS                    L1498         L24133/16
@0648 BJ0894 R 294                          L24133/16
@0649 BJ0895 B 290                          L24133/16
@0650 BJ0896 A 290                          L24133/16
@0651 BJ0897 Y 21                           L1498         L24133/16
 7026 AK8413 TBM 7026                       L24133/16
@0653 BJ0898 S 294                          L24133/16     L24813
@0654 BJ0899 C 290                          L24133/16
@0655 BJ0900 D 290                          L24133/16
@0656 BJ0901 E 290                          L24133/16
@0657 BJ0902 F 290                          L24133/16
@0658 BJ0903 H 290                          L24133/16
@0659 BJ0904 G 290                          L24133/16
@0660 BJ0905 GAGING STATION USGS            L24133/16
@0661 BJ0906 T 294                          L24133/16     L24813
@0662 BJ0907 J 290                          L24133/16
@0663 BJ0908 K 290                          L24133/16
@0664 BJ0909 ALLEN RM 2                     L24133/16
@0665 BJ0910 ALLEN RM 3                     L24133/16
@0666 BJ0911 ALLEN RESET                    L24133/16
@0667 BJ0912 P 290                          L24133/16
@0668 BJ0913 N 290                          L24133/16
@0669 BJ0914 M 290                          L24133/16
@0670 BJ0915 L 290                          L24133/16
@0671 BJ0916 TT 13 L                        L1498         L24133/16     L24813
@0672 BJ0917 V 294                          L24133/16
@0673 BJ0918 U 294                          L24133/16
@0674 BJ0919 W 294                          L24133/16
@0675 BJ0920 U 21                      ( 1) L1498         L24133/16
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*******************************************************
@0676 BJ0921 X 294                          L24133/16     L24593
@0677 BJ0922 Y 294                          L24133/16
@0678 BJ0923 TT 14 L USGS                   L1498         L24133/16
@0679 BJ0924 G 295                          L24133/16     L24813
@0680 BJ0925 F 295                          L24133/16     L24813
@0681 BJ0926 E 295                          L24133/16     L24813
@0682 BJ0927 C 295                          L24133/16
@0683 BJ0928 B 295                          L24133/16
@0684 BJ0929 Z 178                     ( 1) L17766        L19634
L24133/16
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*******************************************************
@0685 BJ0930 Y 178                          L17766        L19634
L24133/16
@0686 BJ0931 D 295                          L24133/16
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@0687 BJ0932 Z 294                        L24133/16     L24969        L25338
@0688 BJ0933 P 19                         L1486         L17766        L19634
L21828        L24133/16     L24593
                                          L24969        L25338        L8423/2
@0689 BJ0934 P 275                  ( 1)  L21828        L24133/16     L24969
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********************************************************
@0690 BJ0935 TT 16 L RESET                L19634        L21828
L24133/16     L24969        L25338
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@ = navd 88 adjusted mark
M = navd 88 crustal motion height

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 SPSN  ACRN  DESIGNATION              SP

@0691 BJ0936 1101                         L1486         L1495         L17766
L19634        L21828        L24133/16
                                          L24969        L8423/2
@0692 BJ0937 HAMMOND RESET                L21828        L24133/16     L24969
L25338
@2999 BJ0940 A 295                  ( 1)  L24133/16     L24969
@3000 BJ0941 S 21                   ( 1)  L1495         L17766        L19634
L24133/16     L8423/2
********************************************************************************
********************************************************
@0693 BJ0939 TA 268                       L19634        L21828
L24133/16     L24969
@0694 BJ0938 TA 253                       L19634        L21828
L24133/16     L24969
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@ = navd 88 adjusted mark
M = navd 88 crustal motion height or one mark tie

HGZ = L24813   ORDER CLASS = 21

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BATON ROUGE TO HAMMOND VIA INTERSTATE HIGHWAY 12
Leveling from 11/02/83 to 07/06/84
Agency = LADTD    First three states = LA

 SPSN  ACRN  DESIGNATION              SP

@1301 BJ0875 Q 286                          L24133/16     L24813
L25082/29
@1302 BJ0874 STEVENS RM 3                   L24133/16     L24813
@1303 BJ0873 STEVENS RESET                  L24133/16     L24813
 1304 BJ3760 STEVENS RM 2                   L24813
@1305 BJ3761 STEVENS AZ MK 2                L24813        L25082/29
 1306 BJ3762 229 AZ MK 2                    L24813
@1307 BJ3763 229 73                         L24813        L25082/26
L25082/29
 1308 BJ3764 17 D 003                       L24813
 1309 BJ3765 17 D 002                ( 1)  L24813
 1310 BJ3766 17 D 001                ( 1)  L24813
 1311 BJ3767 HARE RM 2               ( 1)  L24813
@1312 BJ3768 HARE                    ( 1)  L24813        L25082/25
L25082/26    L25082/27
@1313 BJ3769 HARE RM 1               ( 1)  L24813        L25082/27
@1314 BJ3770 17 C 002                ( 1)  L24813        L25082/27
 1315 BJ3771 17 C 001                ( 1)  L24813
 1316 BJ3772 LANE RM 1               ( 1)  L24813
 1317 BJ3773 LANE                    ( 1)  L24813
 1318 BJ3774 LANE RM 2               ( 1)  L24813
********************************************************************************
********************************************************
 1319 BJ3775 17 D 004                       L24813
 1320 BJ3776 17 D 005                       L24813
@1321 BJ0877 M 286                   ( 1)  L24133/16     L24813
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********************************************************
 1322 BJ3777 DENHAM AZ MK                   L24813
 1323 BJ3778 DENHAM RM 3                    L24813
 1324 BJ3779 DENHAM                         L24813
 1325 BJ3780 DENHAM RM 4                    L24813
 1326 BJ3781 32 A 001                       L24813
 1327 BJ3782 32 A 002                       L24813
 1328 BJ3783 COYEL RM 2                     L24813
 1329 BJ3784 COYEL                          L24813
 1330 BJ3785 COYEL RM 1                     L24813
 1331 BJ3786 COYEL AZ MK             ( 1)  L24813
********************************************************************************
********************************************************
 1332 BJ3787 32 B 001                       L24813
 1333 BJ3788 32 B 002                       L24813
 1334 BJ3789 32 B 003                       L24813
@1335 BJ0888 T 286                   ( 1)  L24133/16     L24813
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********************************************************
 1336 BJ3790 32 B 004                       L24813
 1337 BJ3791 DUMP AZ MK                     L24813
 1338 BJ3792 DUMP                           L24813
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 1339 BJ3793 32 C 001                      L24813
@ = navd 88 adjusted mark
M = navd 88 crustal motion height

 SPSN  ACRN  DESIGNATION                SP

 1340 BJ3794 SUMA                          L24813
 1341 BJ3795 SUMA AZ MK               ( 1)  L24813
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 1342 BJ3796 32 D 001                      L24813
 1343 BJ3797 32 V 5                        L24813
 1344 BJ3798 32 D 002                      L24813
 1345 BJ3799 32 V 1                   ( 1)  L24813
@1346 BJ0898 S 294                    ( 1)  L24133/16     L24813
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*******************************************************
 1347 BJ3800 RED OAK AZ MK                 L24813
 1348 BJ3801 32 D 003                      L24813
 1349 BJ3802 RED OAK RM 2                  L24813
 1350 BJ3803 RED OAK                       L24813
 1351 BJ3804 RED OAK RM 1                  L24813
 1352 BJ3805 32 E 001                      L24813
 1353 BJ3806 32 E 002                      L24813
 1354 BJ3807 32 E 003                      L24813
 1355 BJ3808 32 E 004                      L24813
 1356 BJ3809 CAT AZ MK                     L24813
 1357 BJ3810 32 V 2                   ( 1)  L24813
 1358 BJ3811 32 V 3                   ( 1)  L24813
@1359 BJ0906 T 294                    ( 1)  L24133/16     L24813
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*******************************************************
 1360 BJ3812 32 E 005                      L24813
 1361 BJ3813 CAT                           L24813
 1362 BJ3814 32 F 001                      L24813
 1363 BJ3815 32 F 002                      L24813
 1364 BJ3816 32 F 003                      L24813
 1365 BJ3817 32 V 4                   ( 1)  L24813
@1366 BJ0916 TT 13 L                  ( 1)  L1498         L24133/16     L24813
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*******************************************************
 1367 BJ3818 32 V 6                        L24813
 1368 BJ3819 32 F 004                      L24813
 1369 BJ3820 32 F 005                      L24813
 1370 BJ3821 32 F 006                      L24813
 1371 BJ3822 32 F 007                      L24813
 1372 BJ3823 32 F 008                      L24813
 1373 BJ3824 32 F 009                      L24813
@1374 BJ0925 F 295                          L24133/16     L24813
@1375 BJ0926 E 295                    ( 1)  L24133/16     L24813
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@1376 BJ0924 G 295                          L24133/16     L24813

@ = navd 88 adjusted mark
M = navd 88 crustal motion height or one mark tie
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NMO L24133/16

BATON ROUGE TO HAMMOND

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS

ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

LINES	O/C	AGENCY	YR
L24133/16	11	NGS	1976
L24813	21	LADTD	1984
L1498	20	NGS	1934

THE FOLLOWING DATA ARE FOR THE BASE LINE L24133/16

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
BJ0555	Q 287	B	16.31800	0.00	0
BJ0858	C 287	C	17.74455	1.30	0
BJ0859	D 287	B	19.40722	2.13	0
BJ0860	E 287	C	15.22358	3.76	0
BJ0861	F 287	B	16.46756	5.26	0
BJ0862	T 216	C	17.04287	6.99	0
AK8410	TBM 7025		17.72829	7.67	0
BJ0863	U 216	B	16.23150	8.50	0
BJ0864	V 216	C	15.57481	10.05	0
BJ0865	G 287	C	15.32731	11.79	0
AK8411	TBM 7024		15.13788	12.29	0
BJ0866	E 22	C	15.87417	12.65	0
BJ0867	X 216	C	14.82228	13.83	0
BJ0868	R 287	B	13.32834	15.18	0
BJ0869	S 286	B	12.95909	16.67	0
BJ0870	17 K 004	C	13.70551	18.14	0
BJ0871	R 286	D	13.36171	19.19	0
BJ0872	17 K 006	C	12.65181	20.08	0
BJ0873	STEVENS RESET	C	11.94732	20.86	0
BJ0874	STEVENS RM 3	C	11.40121	20.87	0
BJ0875	Q 286	B	13.16488	21.07	0
AK8412	TBM 7023		12.81590	21.51	0
BJ0876	P 286	B	12.21904	21.91	0
BJ0877	M 286	D	11.74921	23.57	0
BJ0878	N 286	C	12.12365	24.53	0
BJ0879	P 294	B	15.20228	25.70	0
BJ0880	B 22	D	15.35755	25.83	1
BJ0881	X 287	C	13.09911	26.93	0
BJ0882	Y 287	C	14.07268	28.60	0
BJ0883	TT 7 L USGS	C	13.61906	29.69	0

BATON ROUGE TO HAMMOND

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
BJ0884	Z 287	C	12.93756	30.71	0
BJ0885	L 286	C	13.70274	32.36	0
BJ0886	Q 294	B	13.53969	33.76	0
BJ0887	W 286	B	14.24270	34.86	0
BJ0888	T 286	D	13.55527	35.34	0
BJ0889	U 286	C	13.59838	36.33	0
BJ0890	V 286	B	14.87094	37.19	0
BJ0891	X 286	D	14.34585	38.81	0
BJ0892	Y 286	D	14.39964	40.05	0
BJ0893	TT 9 L USGS	C	13.42644	41.08	0
BJ0894	R 294	B	13.58144	41.12	0
BJ0895	B 290	D	12.98271	42.06	0
BJ0896	A 290	D	12.86031	42.86	0
BJ0897	Y 21	D	12.60423	44.22	0
AK8413	TBM 7026		12.20284	45.48	0
BJ0898	S 294	B	12.94748	46.33	0
BJ0899	C 290	D	13.59721	46.65	0
BJ0900	D 290	D	12.58057	47.72	0
BJ0901	E 290	B	11.05422	49.17	0
BJ0902	F 290	B	10.88858	50.29	0
BJ0903	H 290	D	11.47867	51.50	0
BJ0904	G 290	B	12.99871	52.94	0
BJ0905	GAGING STATION USGS	B	13.00378	52.97	0
BJ0906	T 294	B	11.52144	53.80	0
BJ0907	J 290	D	12.13347	54.09	0
BJ0908	K 290	D	12.48907	55.35	0
BJ0909	ALLEN RM 2	C	12.68108	56.39	0
BJ0910	ALLEN RM 3	C	12.71834	56.41	0
BJ0911	ALLEN RESET	C	12.80432	56.43	0
BJ0912	P 290	D	13.27475	57.56	0
BJ0913	N 290	D	13.66822	58.95	0
BJ0914	M 290	B	13.90382	59.77	0
BJ0915	L 290	D	12.54978	61.03	0
BJ0916	TT 13 L	C	12.37411	62.00	0
BJ0917	V 294	B	10.37115	62.56	0
BJ0918	U 294	B	11.26045	62.77	0
BJ0919	W 294	C	10.89455	64.37	0
BJ0920	U 21	C	11.69767	64.44	1
BJ0921	X 294	B	10.23294	65.62	0
BJ0922	Y 294	D	12.15735	66.64	0
BJ0923	TT 14 L USGS	C	12.32401	66.86	0
BJ0924	G 295	C	11.98600	68.09	0
BJ0925	F 295	B	12.05410	69.38	0
BJ0926	E 295	B	13.27811	69.80	0
BJ0927	C 295	D	11.67033	70.75	0
BJ0928	B 295	B	11.58915	71.86	0

BATON ROUGE TO HAMMOND

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
BJ0929	Z 178	D	12.32537	72.24	1
BJ0930	Y 178	D	11.67459	72.23	0
BJ0931	D 295	D	11.41011	73.34	0
BJ0932	Z 294	B	13.24337	73.91	0
BJ0933	P 19	B	14.62078	73.99	0
BJ0934	P 275	D	12.87794	74.13	1
BJ0935	TT 16 L RESET	C	14.20370	74.28	0
BJ0936	1101	C	12.51970	74.32	0
BJ0937	HAMMOND RESET	C	13.03936	74.66	0
BJ0940	A 295	B	12.35691	75.11	1
BJ0941	S 21	C	12.13608	76.10	1
BJ0939	TA 268	A	10.77714	75.56	0
BJ0938	TA 253	A	10.39681	75.71	0

BATON ROUGE TO HAMMOND

Each of the level lines listed below has bench marks common to the base line L24133/16
and the first common mark is considered equivalent to the elevation of the base line.
Therefore the difference is 0.00. Each subsequent common mark is the difference of the elevation from the first common mark, minus the equivalent difference on the base line, in millimeters.

DESIGNATION AND	STABILITY	DIST	L24813	L1498
E 22	C	12.65		0.00
STEVENS RESET	C	20.86	0.00	
STEVENS RM 3	C	20.87	29.81	
Q 286	B	21.07	26.69	
M 286	D	23.57	17.66	
B 22	D	25.83		-114.85
TT 7 L USGS	C	29.69		-135.35
T 286	D	35.34	8.26	
TT 9 L USGS	C	41.08		-168.21
Y 21	D	44.22		-162.47
S 294	B	46.33	-4.46	
T 294	B	53.80	-5.97	
TT 13 L	C	62.00	-10.62	-135.69
U 21	C	64.44		-133.93
TT 14 L USGS	C	66.86		-154.22
G 295	C	68.09	-6.83	
F 295	B	69.38	-11.17	
E 295	B	69.80	-26.86	

HGZ = L24133/17   ORDER CLASS = 11

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NEW ORLEANS DISTRICT CORPS OF ENGINEERS LEVELING
BATON ROUGE TO 2 MI N OF UNION
Leveling from 08/11/76 to 04/28/77
Agency = NGS      First three states = LA

 SPSN  ACRN  DESIGNATION               SP

@1002 BJ0555 Q 287                          L24133/10     L24133/16
L24133/17     L24133/9      L25082/21
@2990 BJ0958 J 22                           L1498         L20214        L20217
L24133/17     L24962/1      L24970
                                            L5734
 1063 BJ0959 P 296                          L24133/17
 7607 AK8906 TBM 7607                       L24133/17
 1064 BJ0960 L 22                           L1498         L19631        L20196
L20217        L24133/17     L8069

@1008 BJ0961 17 B 013                       L24133/17     L24962/1      L24970
L25082/21
@1065 BJ0962 C 204                          L20196        L24133/17     L24962/1
L24970        L25082/21
 7606 AK8907 TBM 7606                       L24133/17
 1066 BJ0963 B 197 WELL               ( 1)  L19631        L20196
L24133/17
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 1067 BJ0964 2                              L1498         L19631        L20196
L24133/17     L8069
 7605 AK8908 TBM 7605                 ( 1)  L24133/17
 1068 BJ0965 XXXI                     ( 2)  L19631        L20196
L24133/17     L8069
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********************************************************
 1069 BJ0966 NORTH BOULEVARD CAP      ( 1)  L19631        L20196
L24133/17     L8069
 1070 BJ0967 POST OFFICE              ( 1)  L1498         L19631        L20196
L24133/17     L8069
 1071 BJ0968 K 22                     ( 1)  L1498         L19631        L20196
L24133/17     L8069
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********************************************************
 7604 AK8909 TBM 7604                       L24133/17
@0631 BJ0969 M 197                    ( 1)  L19631        L24133/17
L25082/22
@0632 BJ0970 N 197                    ( 1)  L19631        L24133/17
L25082/22
@0633 BJ0971 P 197                    ( 1)  L19631        L24133/17
L25082/22
@0634 BJ0972 Q 197                    ( 1)  L19631        L24133/17
L25082/22
@0635 BJ0973 M 288                    ( 1)  L24133/17     L25082/22
 7601 AK8910 TBM 7601                 ( 1)  L24133/17
 0636 BJ0974 R 197 WELL               ( 1)  L19631        L24133/17
 7600 AK8911 TBM 7600                 ( 1)  L24133/17
 0637 BJ0975 W 197                    ( 2)  L19631        L24133/17
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@0638 BJ0976 L 288                    ( 1)  L24133/17     L25082/22
L25082/25
@0639 BJ0977 N 288                    ( 1)  L24133/17     L25082/22
 0640 BJ0978 U 197                    ( 1)  L19631        L24133/17
@0641 BJ0979 V 197                    ( 1)  L19631        L24133/17
L25082/22
 1005 BJ0980 DONAIR RM 2              ( 1)  L24133/17
 1006 BJ0981 DONAIR                   ( 1)  L24133/17
 1007 BJ0982 DONAIR RM 1              ( 1)  L24133/17
 1012 BJ0983 102 EBRPAR               ( 1)  L24133/17
 1011 BJ0984 DONAIR AZ MK             ( 1)  L24133/17
@1009 BJ0985 A 3045 A                 ( 1)  L24133/17     L25082/22
L25082/23
@1010 BJ0986 ROUGE                    ( 2)  L24133/17     L25082/22

@ = navd 88 adjusted mark
M = navd 88 crustal motion height

 SPSN  ACRN  DESIGNATION               SP

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*******************************************************
 7608 AK8912 TBM 7608                 ( 1)  L24133/17
@1013 BJ0987 17                       ( 1)  L24133/17     L25082/23
@0574 BJ0862 T 216                    ( 1)  L20214        L24133/16
L24133/17     L25082/17     L25082/18     L25082/23

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*******************************************************
@1072 BJ0988 J 288                          L24133/17     L24970
L25082/21     L25082/22     L25082/24     L25082/35

 7610 AK8913 TBM 7610                       L24133/17
 1073 BJ0989 C 198                    ( 1)  L19631        L24133/17
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*******************************************************
@1074 BJ0990 K 288                          L24133/17     L24970
L25082/35
@1075 BJ0991 D 197                          L19631        L21853
L24133/17     L24970        L25082/35
 1076 BJ0992 C 927 LAGS                     L19631        L21853
L24133/17
@1077 BJ0993 C 929                          L19631        L21853
L24133/17     L24970
@1078 BJ0994 C 930                          L19631        L21853
L24133/17     L24970
@1079 BJ0995 ARLINGTON CAP RESET            L19631        L21853
L24133/17     L24970
@1080 BJ0996 B 198                          L19631        L21853
L24133/17     L24970
@1081 BJ0997 W 94 RESET                     L19631        L24133/17     L24970
@1082 BJ0998 C 936                          L19631        L24133/17     L24970
 1083 BJ0999 XXV11                          L19631        L24133/17     L8069
 1084 BJ1000 C 940                          L19631        L24133/17
@1085 BJ1001 E 197                          L19631        L24133/17     L24970
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 7404 AK8914 TBM 7404                       L24133/17
 1086 BJ1002 C 944                          L19631        L24133/17
@1088 BJ1003 L 197 RESET                    L24133/17     L24970
@1089 BJ1004 K 197 RESET                    L24133/17     L24970
@1090 BJ1005 P 288                          L24133/17     L24970
@1091 BJ1006 A 198                          L19631        L21853
L24133/17     L24970
@1092 BJ1007 BURTVILLE RM 3                 L19631        L21853
L24133/17     L24970
 1093 BJ1008 BURTVILLE RESET                L21853        L24133/17
@1094 BJ1009 J 197                          L19631        L24133/17     L24970
@1095 BJ1010 RIVER MISSISSIPPI MP 15        L19631        L24133/17     L24970
@1096 BJ1011 H 197                          L19631        L24133/17     L24970
@1097 BJ1012 RIVER MISSISSIPPI MP 16        L19631        L24133/17     L24970
@1098 BJ1013 G 197                          L19631        L24133/17     L24970
@1099 BJ1014 IB 44                          L19631        L24133/17     L24970
 1100 BJ1015 PERTUIT                        L19631        L24133/17     L8069
@1101 BJ1016 Q 288                          L24133/17     L24970
 7405 AK8915 TBM 7405                       L24133/17
 1102 BJ1017 IB 40 USGS               ( 1)  L19631        L24133/17
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@1103 BJ1018 RIVER MISSISSIPPI MP 20        L19631        L24133/17     L24970
@1003 BJ1019 F 197                          L19631        L20202
L24133/17     L24970
 7602 AK8916 TBM 7602                 ( 1)  L24133/17
 7603 AK8917 TBM 7603                 ( 1)  L24133/17
@0547 BJ0579 X 290                    ( 1)  L24133/11     L24133/12
L24133/15     L24133/17
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********************************************************
@1105 BJ1020 Q 94 RESET                     L19631        L20202
L24133/17     L24970

@ = navd 88 adjusted mark
M = navd 88 crustal motion height

 SPSN  ACRN  DESIGNATION              SP

@1106 BJ1021 178 2 RESET                    L19631        L24133/17     L24970
@1107 BJ1022 P 94 RESET                     L19631        L24133/17     L24970
 1108 BJ1023 IB 41 USGS                     L19631        L24133/17
@1109 BJ1024 N 94 RESET                     L19631        L24133/17     L24970
@1110 BJ1025 ANGER RESET                    L19631        L24133/17     L24970
@1111 BJ1026 R 288                          L24133/17     L24970
 1112 BJ1027 IB 47                          L19631        L24133/17
 7406 AK8918 TBM 7406                       L24133/17
 1113 BJ1028 GAGE 32 BOLT             ( 1)  L19631        L24133/17     L8069
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@1475 BJ1029 L 94                           L19631        L21853
L24133/17     L24970        L8069
@1476 BJ1030 K 94                           L19631        L21853
L24133/17     L24970        L8069
@1404 BJ1031 K 297                          L24133/17     L24970
 1478 BJ1032 24 A 001                 ( 1)  L24133/17
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@1403 BJ1033 RIVER MISSISSIPPI MP 30        L19631        L24133/17     L24970
@1405 BJ1034 3004                           L19631        L24133/17     L24970
L8069
 1406 BJ1035 180 B CAP                      L19631        L24133/17     L8069
 1407 BJ1036 J 94 RESET                     L24133/17
 7407 AK8919 TBM 7407                       L24133/17
 1408 BJ1037 GAGE 31 CAP              ( 1)  L19631        L24133/17     L8069
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@1409 BJ1038 X 192                          L19631        L24133/17     L24970
@1410 BJ1039 RIVER MISSISSIPPI MP 33        L19631        L24133/17     L24970
 1411 BJ1040 H 94                           L19631        L24133/17     L8069
@1412 BJ1041 RIVER MISSISSIPPI MP 34        L19631        L24133/17     L24970
@1413 BJ1042 W 192                          L19631        L24133/17     L24970
@1414 BJ1043 RIVER MISSISSIPPI MP 35        L19631        L24133/17     L24970
 1415 BJ1044 CURLEY CAP               ( 1)  L19631        L24133/17     L8069
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@1416 BJ1045 V 192                          L19631        L24133/17     L24970
@1417 BJ1046 RIVER MISSISSIPPI MP 36        L19631        L24133/17     L24970
@1419 BJ1047 N 297                          L24133/17     L24970
@1420 BJ1048 F 94                           L19631        L24133/17     L24970
L8069
 7408 AK8076 TBM 7408                       L24133/17
 1421 BJ1049 IB 58                    ( 1)  L19631        L24133/17
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@1422 BJ1050 RIVER MISSISSIPPI MP 38        L19631        L24133/17     L24970
@1423 BJ1051 U 192                          L19631        L24133/17     L24970
@1424 BJ1052 E 94                           L19631        L24133/17     L24970
L8069
@1425 BJ1053 RIVER MISSISSIPPI MP 40        L19631        L24133/17     L24970
 1426 BJ1054 M 297                          L24133/17
@1427 BJ1055 CARVILLE CAP             ( 1)  L19631        L24133/17     L24970
L8069
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 7409 AK8077 TBM 7409                       L24133/17
@1428 BJ1056 3009                           L19631        L24133/17     L24970
L8069
 1429 BJ1057 3010                           L19631        L24133/17     L8069
@1430 BJ1058 RIVER MISSISSIPPI MP 42        L19631        L24133/17     L24970

@ = navd 88 adjusted mark
M = navd 88 crustal motion height

 SPSN  ACRN  DESIGNATION                   SP

@1431 BJ1059 3011                           L19631        L24133/17     L24970
L8069
@2998 BJ1060 RUSSELL CAP                    L19631        L24133/17     L24970
L8069
 7410 AK8078 TBM 7410                       L24133/17
 1432 BJ1061 R 192                          L19631        L21853
L24133/17
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 1433 BJ1062 3017 RESET                     L21853        L24133/17
 1436 BJ1063 GEISMAR RM 6             ( 1)  L24133/17
 1434 BJ1064 GEISMAR                  ( 1)  L19631        L21853
L24133/17     L8069
@1435 BJ1065 GEISMAR RM 5             ( 1)  L21853        L24133/17     L24970
@1437 BJ1066 NEW RIVER CAP            ( 1)  L19631        L21853
L24133/17     L24970        L8069
 1438 BJ1067 3 V 13 LADH              ( 1)  L21853        L21859
L24133/17
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 1439 BJ1068 D 94 RESET                     L19631        L24133/17
 7411 AK8079 TBM 7411                       L24133/17
@1441 BJ1069 C 94 RESET               ( 1)  L19631        L24133/17     L24970
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@1442 BJ1070 P 297                          L24133/17     L24970
@1444 BJ1071 P 192                          L19631        L24133/17     L24970
@1445 BJ1072 A 94 RESET                     L19631        L24133/17     L24970
 7412 AK8080 TBM 7412                       L24133/17
 7413 AK8081 TBM 7413                       L24133/17
@1449 BJ1073 L 297                          L24133/17     L24970
 1450 BJ1074 187/2 CAP                      L19631        L24133/17     L8069
@1451 BJ1075 Z 197                          L19631        L24133/17     L24970
@1452 BJ1076 TT 3 P RESET                   L19631        L24133/17     L24970
 1453 BJ1077 BRINGIER CAP                   L19631        L24133/17     L8069
 1454 BJ1078 RIVER MISSISSIPPI MP 56        L19631        L24133/17
 1455 BJ1079 YY 93                          L19631        L24133/17     L8069
 1456 BJ1080 188/1 CAP                      L19631        L24133/17     L8069
 1457 BJ1081 XX 93                          L19631        L24133/17     L8069
 7414 AK8082 TBM 7414                       L24133/17
@1459 BJ1082 N 192                          L19631        L24133/17     L24970
 1460 BJ1083 189/1 CAP                      L19631        L24133/17     L8069
@1461 BJ1084 M 192                          L19631        L24133/17     L24970
@1462 BJ1085 L 192                          L19631        L21853        L21856
L24133/17     L24970
 1463 BJ1086 MILES RM 4               ( 1)  L19631        L21853
L24133/17
 1465 BJ1087 MILES RM 3               ( 1)  L19631        L21853
L24133/17
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@1466 BJ1088 Q 297                          L24133/17     L24970
 1467 BJ1089 K 192 RESET 1965               L21856        L24133/17
 1468 BJ1090 J 192                          L19631        L24133/17
 1469 BJ1091 1091 LAGS                      L19631        L24133/17     L8069
@1471 BJ1092 H 192                          L19631        L20373
L24133/17     L24970
 1473 BJ1093 L 229                    ( 1)  L20373        L24133/17
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 1481 BJ1094 R 297                          L24133/17
@1482 BJ1096 T 297                    ( 1)  L24133/12     L24133/17
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@1480 BJ1095 S 297                          L24133/17     L24970
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@ = navd 88 adjusted mark
M = navd 88 crustal motion height

SPSN	ACRN	DESIGNATION	SP

@ = navd 88 adjusted mark
M = navd 88 crustal motion height or one mark tie

NMO L24133/17

BATON ROUGE TO UNION

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS

ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

LINES	O/C	AGENCY	YR
L24133/17	11	NGS	1977
L24970	12	NGS	1986
L19631	12	NGS	1964
L8069	12	NGS	1938

THE FOLLOWING DATA ARE FOR THE BASE LINE L24133/17

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
BJ0555	Q 287	B	16.31800	0.00	0
BJ0958	J 22	C	15.54953	0.22	0
BJ0959	P 296	B	17.00661	0.84	0
AK8906	TBM 7607		14.28208	1.21	0
BJ0960	L 22	D	19.92023	1.47	0
BJ0961	17 B 013	C	16.10786	1.73	0
BJ0962	C 204	C	13.27296	2.14	0
AK8907	TBM 7606		11.74646	2.71	0
BJ0963	B 197 WELL	D	10.50777	2.75	1
BJ0964	2	D	11.43851	2.84	0
AK8908	TBM 7605		17.37708	2.96	1
BJ0965	XXXI	B	18.54422	3.01	2
BJ0966	NORTH BOULEVARD CAP	D	16.70007	3.17	1
BJ0967	POST OFFICE	B	17.62480	3.20	1
BJ0968	K 22	D	12.00813	2.95	1
AK8909	TBM 7604		9.54203	3.17	0
BJ0969	M 197	C	11.22538	3.95	1
BJ0970	N 197	B	15.05684	4.35	1
BJ0971	P 197	C	17.06767	4.87	1
BJ0972	Q 197	C	13.41981	6.23	1
BJ0973	M 288	C	13.79522	6.88	1
AK8910	TBM 7601		15.70659	7.47	1
BJ0974	R 197 WELL	D	15.53009	7.96	1
AK8911	TBM 7600		16.28803	8.44	1
BJ0975	W 197	D	16.84317	8.79	2
BJ0976	L 288	C	17.06386	9.24	1
BJ0977	N 288	C	16.53358	10.18	1
BJ0978	U 197	D	15.97020	11.17	1
BJ0979	V 197	C	15.65466	11.27	1

BATON ROUGE TO UNION

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
BJ0980	DONAIR RM 2	C	15.16077	11.54	1
BJ0981	DONAIR	C	15.08263	11.55	1
BJ0982	DONAIR RM 1	C	15.19287	11.56	1
BJ0983	102 EBRPAR	C	15.27921	11.79	1
BJ0984	DONAIR AZ MK	C	15.21128	12.73	1
BJ0985	A 3045 A	C	14.79382	12.92	1
BJ0986	ROUGE	C	19.67503	13.61	2
AK8912	TBM 7608		14.95015	13.89	1
BJ0987	17	C	15.60428	14.89	1
BJ0862	T 216	C	17.04641	15.55	1
BJ0988	J 288	B	10.72699	3.76	0
AK8913	TBM 7610		8.70346	4.27	0
BJ0989	C 198	B	14.59654	5.20	1
BJ0990	K 288	C	9.88917	4.53	0
BJ0991	D 197	C	10.93628	5.42	0
BJ0992	C 927 LAGS	C	7.57856	6.70	0
BJ0993	C 929	C	7.59583	8.08	0
BJ0994	C 930	C	7.45662	8.63	0
BJ0995	ARLINGTON CAP RESET	D	7.51859	8.67	0
BJ0996	B 198	B	7.46716	10.05	0
BJ0997	W 94 RESET	C	8.42031	11.71	0
BJ0998	C 936	C	9.22653	13.04	0
BJ0999	XXV11	C	9.16909	14.37	0
BJ1000	C 940	C	11.53978	15.11	0
BJ1001	E 197	C	8.75665	16.07	0
AK8914	TBM 7404		8.71514	16.92	0
BJ1002	C 944	C	12.67568	17.63	0
BJ1003	L 197 RESET	C	6.65683	19.35	0
BJ1004	K 197 RESET	D	7.35094	20.80	0
BJ1005	P 288	C	8.15628	22.23	0
BJ1006	A 198	B	8.07930	23.65	0
BJ1007	BURTVILLE RM 3	C	6.70795	25.39	0
BJ1008	BURTVILLE RESET	C	6.84162	25.43	0
BJ1009	J 197	C	8.09259	27.25	0
BJ1010	RIVER MISSISSIPPI MP 15	D	7.33315	27.87	0
BJ1011	H 197	C	7.25604	28.78	0
BJ1012	RIVER MISSISSIPPI MP 16	D	7.57935	29.75	0
BJ1013	G 197	C	7.49263	29.95	0
BJ1014	IB 44	A	7.09189	31.22	0
BJ1015	PERTUIT	C	8.21128	32.37	0
BJ1016	Q 288	C	7.47074	34.03	0
AK8915	TBM 7405		8.37798	35.66	0
BJ1017	IB 40 USGS	D	8.12462	35.82	1
BJ1018	RIVER MISSISSIPPI MP 20	D	8.56439	35.97	0
BJ1019	F 197	C	8.56737	36.27	0
AK8916	TBM 7602		4.92467	37.14	1

BATON ROUGE TO UNION

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
AK8917	TBM 7603		6.22679	37.72	1
BJ0579	X 290	B	8.05686	38.00	1
BJ1020	Q 94 RESET	C	8.33707	37.67	0
BJ1021	178 2 RESET	C	8.31178	39.10	0
BJ1022	P 94 RESET	C	8.56242	39.91	0
BJ1023	IB 41 USGS	D	7.29013	41.56	0
BJ1024	N 94 RESET	C	7.71441	41.79	0
BJ1025	ANGER RESET	D	7.73024	42.41	0
BJ1026	R 288	C	7.13993	43.66	0
BJ1027	IB 47	D	7.23649	45.00	0
AK8918	TBM 7406		7.19640	46.11	0
BJ1028	GAGE 32 BOLT	D	6.23394	46.17	1
BJ1029	L 94	C	6.96923	47.98	0
BJ1030	K 94	C	6.72578	49.77	0
BJ1031	K 297	B	7.60782	50.00	0
BJ1032	24 A 001	C	6.22619	50.48	1
BJ1033	RIVER MISSISSIPPI MP 30	C	5.67879	51.12	0
BJ1034	3004	C	6.21220	52.34	0
BJ1035	180 B CAP	D	7.10023	52.60	0
BJ1036	J 94 RESET	C	7.33312	53.78	0
AK8919	TBM 7407		6.54917	54.80	0
BJ1037	GAGE 31 CAP	D	6.51804	55.11	1
BJ1038	X 192	C	7.04608	55.15	0
BJ1039	RIVER MISSISSIPPI MP 33	D	7.41719	55.97	0
BJ1040	H 94	C	7.78284	56.64	0
BJ1041	RIVER MISSISSIPPI MP 34	D	7.16495	57.48	0
BJ1042	W 192	C	7.39369	57.55	0
BJ1043	RIVER MISSISSIPPI MP 35	D	7.58005	58.80	0
BJ1044	CURLEY CAP	A	7.37033	59.22	1
BJ1045	V 192	C	7.65574	58.90	0
BJ1046	RIVER MISSISSIPPI MP 36	D	7.71407	60.27	0
BJ1047	N 297	B	8.37018	60.60	0
BJ1048	F 94	C	7.45534	61.94	0
AK8076	TBM 7408		7.86243	62.84	0
BJ1049	IB 58	D	7.11200	63.16	1
BJ1050	RIVER MISSISSIPPI MP 38	D	7.55648	63.22	0
BJ1051	U 192	C	7.43008	63.40	0
BJ1052	E 94	C	6.91402	64.74	0
BJ1053	RIVER MISSISSIPPI MP 40	D	6.63978	66.24	0
BJ1054	M 297	B	7.02720	66.41	0
BJ1055	CARVILLE CAP	D	6.29443	66.79	1
AK8077	TBM 7409		6.60027	67.27	0
BJ1056	3009	C	5.75162	67.96	0
BJ1057	3010	C	5.89032	68.82	0
BJ1058	RIVER MISSISSIPPI MP 42	D	5.65031	69.37	0
BJ1059	3011	C	5.56749	69.55	0

BATON ROUGE TO UNION

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
BJ1060	RUSSELL CAP	D	6.26492	70.98	0
AK8078	TBM 7410		6.40636	71.92	0
BJ1061	R 192	D	5.20467	72.65	0
BJ1062	3017 RESET	C	7.39305	74.27	0
BJ1063	GEISMAR RM 6	C	6.88157	74.49	1
BJ1064	GEISMAR	C	6.79557	74.53	1
BJ1065	GEISMAR RM 5	C	7.00953	74.56	1
BJ1066	NEW RIVER CAP	D	7.35535	74.60	1
BJ1067	3 V 13 LADH	C	5.66373	75.88	1
BJ1068	D 94 RESET	C	6.89690	75.87	0
AK8079	TBM 7411		7.00798	77.57	0
BJ1069	C 94 RESET	C	7.21510	77.80	1
BJ1070	P 297	A	7.43313	78.80	0
BJ1071	P 192	C	7.87868	79.43	0
BJ1072	A 94 RESET	C	5.83167	80.77	0
AK8080	TBM 7412		4.66825	81.98	0
AK8081	TBM 7413		5.46797	83.09	0
BJ1073	L 297	C	5.50069	84.51	0
BJ1074	187/2 CAP	D	7.21041	85.62	0
BJ1075	Z 197	B	6.21385	87.15	0
BJ1076	TT 3 P RESET	C	6.13758	87.94	0
BJ1077	BRINGIER CAP	D	6.12389	88.74	0
BJ1078	RIVER MISSISSIPPI MP 56	C	5.79490	89.94	0
BJ1079	YY 93	C	6.46715	90.49	0
BJ1080	188/1 CAP	D	6.35201	92.08	0
BJ1081	XX 93	C	6.26475	93.55	0
AK8082	TBM 7414		4.10712	94.78	0
BJ1082	N 192	C	4.90345	96.44	0
BJ1083	189/1 CAP	D	4.96464	96.62	0
BJ1084	M 192	C	5.20954	97.41	0
BJ1085	L 192	C	5.99249	98.36	0
BJ1086	MILES RM 4	C	3.12328	99.66	1
BJ1087	MILES RM 3	C	3.11381	99.69	1
BJ1088	Q 297	C	5.78498	99.55	0
BJ1089	K 192 RESET 1965	C	5.54329	101.04	0
BJ1090	J 192	C	4.06461	102.58	0
BJ1091	1091 LAGS	C	4.21341	104.16	0
BJ1092	H 192	B	6.92198	105.48	0
BJ1093	L 229	B	11.09769	106.41	1
BJ1094	R 297	C	6.96840	107.28	0
BJ1096	T 297	B	6.95276	108.11	1
BJ1095	S 297	B	7.23184	107.45	0

BATON ROUGE TO UNION

Each of the level lines listed below has bench marks common to the base line L24133/17
and the first common mark is considered equivalent to the elevation of the base line.
Therefore the difference is 0.00. Each subsequent common mark is the difference of the elevation from the first common mark, minus the equivalent difference on the base line, in millimeters.

DESIGNATION AND STABILITY		DIST	L24970	L19631	L8069
J 22	C	0.22	0.00		
L 22	D	1.47		0.00	0.00
17 B 013	C	1.73	20.83		
C 204	C	2.14	-42.36		
B 197 WELL	D	2.75		-3.98	
2	D	2.84		9.19	-9.86
XXXI	B	3.01		-3.14	-34.92
NORTH BOULEVARD CAP	D	3.17		22.30	-22.25
POST OFFICE	B	3.20		7.16	-24.06
K 22	D	2.95		2.20	-28.83
M 197	C	3.95		-1.94	
N 197	B	4.35		1.47	
P 197	C	4.87		-1.98	
Q 197	C	6.23		-2.02	
R 197 WELL	D	7.96		-12.17	
W 197	D	8.79		-11.79	
U 197	D	11.17		-16.38	
V 197	C	11.27		-10.54	
J 288	B	3.76	-5.56		
C 198	B	5.20		-15.43	
K 288	C	4.53	-26.60		
D 197	C	5.42	-21.89	10.34	
C 927 LAGS	C	6.70		-8.71	
C 929	C	8.08	-23.52	-32.35	
C 930	C	8.63	-14.52	-33.64	
ARLINGTON CAP RESET	D	8.67	-19.64	-23.59	
B 198	B	10.05	-13.40	-45.76	
W 94 RESET	C	11.71	-8.31	-37.78	
C 936	C	13.04	-77.76	-33.43	
XXV11	C	14.37		-16.52	-128.27
C 940	C	15.11		-17.74	
E 197	C	16.07	-10.93	-15.83	
C 944	C	17.63		-6.60	
L 197 RESET	C	19.35	-20.17		
K 197 RESET	D	20.80	-35.14		
P 288	C	22.23	-28.61		
A 198	B	23.65	-27.02	-32.27	
BURTVILLE RM 3	C	25.39	-30.82	369.00	
J 197	C	27.25	-28.86	-32.65	
RIVER MISSISSIPPI MP 15	D	27.87	-29.47	-36.83	

BATON ROUGE TO UNION

DESIGNATION AND STABILITY		DIST	L24970	L19631	L8069
H 197	C	28.78	-25.97	-37.14	
RIVER MISSISSIPPI MP 16	D	29.75	-54.70	-30.95	
G 197	C	29.95	-40.06	-34.84	
IB 44	A	31.22	-32.70	-44.14	
PERTUIT	C	32.37		300.07	166.87
Q 288	C	34.03	-21.82		
IB 40 USGS	D	35.82		-30.24	
RIVER MISSISSIPPI MP 20	D	35.97	-33.47	-23.78	
F 197	C	36.27	-24.10	-26.81	
Q 94 RESET	C	37.67	-43.03	-23.12	
178 2 RESET	C	39.10	-28.34	-25.76	
P 94 RESET	C	39.91	-32.03	-31.81	
IB 41 USGS	D	41.56		-36.14	
N 94 RESET	C	41.79	-24.39	-27.26	
ANGER RESET	D	42.41	-33.06	-18.39	
R 288	C	43.66	-54.19		
IB 47	D	45.00		-29.74	
GAGE 32 BOLT	D	46.17		-31.85	-143.67
L 94	C	47.98	-52.03	13.22	-85.00
K 94	C	49.77	-58.82	-15.32	-59.95
K 297	B	50.00	-64.34		
RIVER MISSISSIPPI MP 30	C	51.12	-41.90	-50.25	
3004	C	52.34	-39.27	-58.56	-193.00
180 B CAP	D	52.60		-54.05	-189.46
GAGE 31 CAP	D	55.11		-50.16	-176.83
X 192	C	55.15	-50.84	-58.52	
RIVER MISSISSIPPI MP 33	D	55.97	-40.97	-51.89	
H 94	C	56.64		-61.36	-201.76
RIVER MISSISSIPPI MP 34	D	57.48	-43.85	-53.05	
W 192	C	57.55	-39.48	-49.76	
RIVER MISSISSIPPI MP 35	D	58.80	-64.25	-46.55	
CURLEY CAP	A	59.22		-23.70	-159.13
V 192	C	58.90	-41.26	-43.84	
RIVER MISSISSIPPI MP 36	D	60.27	-26.56	-52.62	
N 297	B	60.60	-43.47		
F 94	C	61.94	-37.53	-38.46	-170.08
IB 58	D	63.16		-54.41	
RIVER MISSISSIPPI MP 38	D	63.22	-40.36	-51.89	
U 192	C	63.40	-37.42	-52.05	
E 94	C	64.74	-41.03	-52.05	-205.44
RIVER MISSISSIPPI MP 40	D	66.24	-64.76	-38.89	
CARVILLE CAP	D	66.79	-36.00	-63.11	-217.84
3009	C	67.96	-37.41	-53.84	-181.32
3010	C	68.82		-58.45	-207.58
RIVER MISSISSIPPI MP 42	D	69.37	-46.80	-40.71	
3011	C	69.55	-37.61	-49.55	-206.41
RUSSELL CAP	D	70.98	-35.85	-45.73	-96.23

BATON ROUGE TO UNION

DESIGNATION AND STABILITY		DIST	L24970	L19631	L8069
R 192	D	72.65		12.90	
GEISMAR	C	74.53		-61.28	-220.39
GEISMAR RM 5	C	74.56	-41.99		
NEW RIVER CAP	D	74.60	-45.08	-53.21	-227.92
D 94 RESET	C	75.87		-63.10	
C 94 RESET	C	77.80	-60.53	-19.34	
P 297	A	78.80	-73.65		
P 192	C	79.43	-78.48	-9.35	
A 94 RESET	C	80.77	-102.83	34.67	
L 297	C	84.51	-37.48		
187/2 CAP	D	85.62		-40.91	-198.75
Z 197	B	87.15	-68.09	-36.94	
TT 3 P RESET	C	87.94	-72.63	-21.27	
BRINGIER CAP	D	88.74		-38.88	-173.53
RIVER MISSISSIPPI MP 56	C	89.94		-29.96	
YY 93	C	90.49		-46.51	-202.54
188/1 CAP	D	92.08		-26.42	-164.04
XX 93	C	93.55		-42.82	-193.22
N 192	C	96.44	-42.91	-61.93	
189/1 CAP	D	96.62		-37.39	373.47
M 192	C	97.41	-45.19	-61.36	
L 192	C	98.36	-43.74	-56.64	
MILES RM 4	C	99.66		-51.64	
MILES RM 3	C	99.69		-54.21	
Q 297	C	99.55	-41.25		
J 192	C	102.58		-51.20	
1091 LAGS	C	104.16		-48.95	-183.73
H 192	B	105.48	-49.19	-52.19	
S 297	B	107.45	-52.16		

HGZ = L24804/1 ORDER CLASS = 21

SCOTLANDVILLE-ZACHARY-SLAUGHTER-MCMANUS-CLINTON AREA LA
SCOTLANDVILLE VIA STATE HWYS 408, 946, AND 64 TO ZACHARY
Leveling from 08/08/83 to 10/25/83
Agency = LADTD First three states = LA

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 SPSN  ACRN  DESIGNATION               SP

@1163 BJ0506 510                            L24133/9      L24804/1      L24804/5
L25082/15
@1164 BJ0507 Y 284                          L24133/9      L24804/1      L24804/5
@1165 BJ0508 Z 284                          L24133/9      L24804/1
@1004 BJ0531 A 287 RESET 1978               L24804/1
@1005 BJ3370 17 V 39 1983 LADH              L24804/1
@1006 BJ3371 TAYLOR RM 1                    L24804/1
@1007 BJ3372 TAYLOR                         L24804/1      L25082/12
@1008 BJ3373 TAYLOR RM 2                    L24804/1      L25082/12
@1009 BJ3374 17 V 40                        L24804/1      L25082/12
L25082/13
@1010 BJ3375 17 V 41                        L24804/1      L25082/12
@1011 BJ3376 17 V 42                        L24804/1      L25082/12
@1012 BJ3377 BOLO 2 RM 4                    L24804/1
@1013 BJ3378 BOLO 3                         L24804/1      L25082/12
@1014 BJ3379 BOLO 3 RM 5                    L24804/1      L25082/12
@1015 BJ3380 17 V 43                        L24804/1      L25082/12
@1016 BJ3381 17 V 44                        L24804/1      L25082/12
L25082/13
@1017 BJ3382 17 V 45                        L24804/1      L25082/12
@1018 BJ3383 SULLIVAN RM 2                  L24804/1      L25082/11
L25082/12
@1019 BJ3384 SULLIVAN                       L24804/1      L25082/10
L25082/11    L25082/12
@1020 BJ3385 SULLIVAN RM 1                  L24804/1      L25082/10
@1021 BJ3386 SULLIVAN AZ MK                 L24804/1      L25082/11
@1022 BJ3387 17 V 46                        L24804/1      L25082/11
@1023 BJ3388 17 V 9                         L24804/1      L25082/11
@1024 BJ3389 17 V 10               ( 1)  L24804/1      L25082/11
@1025 BJ3390 DYER RM 1             ( 1)  L24804/1      L25082/11     L25082/7
L25082/8
@1026 BJ3391 DYER                  ( 1)  L24804/1      L25082/11     L25082/7
L25082/8
@1027 BJ3392 DYER RM 2             ( 1)  L24804/1      L25082/8
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 1028 BJ3393 17 V 11 LADH                   L24804/1
 1029 BJ3394 17 V 12 LADH                   L24804/1
@1030 BJ3395 17 V 13                        L24804/1      L24804/4      L25082/9
@1031 BJ3396 17 V 14                        L24804/1      L24804/4      L25082/8
L25082/9
@1032 BJ3397 DEERFORD AZ MK        ( 1)  L24804/1
@1033 BJ3398 DEERFORD RM 3         ( 1)  L24804/1
@1034 BJ3399 DEERFORD              ( 1)  L24804/1
@1035 BJ3400 DEERFORD RM 2         ( 1)  L24804/1
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@1036 BJ3401 17 V 15                        L24804/1      L25082/8
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@1037 BJ3402 17 V 16                          L24804/1      L24804/2      L25082/4
L25082/8
@1038 BJ3403 17 R 005                   ( 1)  L24804/1      L25082/4
@1039 BJ3404 17 R 006                   ( 1)  L24804/1      L25082/4
@1040 BJ3405 FLORIDA RM 1               ( 1)  L24804/1      L25082/4      L25082/5

@ = navd 88 adjusted mark
M = navd 88 crustal motion height

 SPSN  ACRN  DESIGNATION                 SP

@1041 BJ3406 FLORIDA                    ( 1)  L24804/1      L25082/4      L25082/5
@1042 BJ3407 FLORIDA RM 2               ( 1)  L24804/1
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@1043 BJ3408 17 V 17 LADH                     L24804/1      L24804/2
@1044 BJ3409 17 V 18 LADH                     L24804/1
@1045 BJ3410 17 V 19 LADH                     L24804/1
@1046 BJ0483 A 912                            L24133/9      L24804/1      L25082/1
L5734
@1051 BJ0482 17 T 006                   ( 1)  L24133/9      L24804/1      L25082/1
@1052 BJ0481 J 219                      ( 1)  L20217        L24133/9      L24804/1
L25082/1
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********************************************************
@1047 BJ0484 ZACHARY                          L24133/9      L24804/1      L25082/1
L25082/4
@1048 BJ0485 ZACHARY RM 4                     L24133/9      L24804/1      L25082/1
@1049 BJ0486 ZACHARY RM 3                     L24133/9      L24804/1      L25082/1
@1050 BJ0487 552                              L24133/9      L24804/1      L25082/1

@ = navd 88 adjusted mark
M = navd 88 crustal motion height or one mark tie
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HGZ = L25082/12   ORDER CLASS = 22

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VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
SULLIVAN VIA 17 V 45 LADH, 17 V 42 LADH, TAYLOR LADH, TO 609 73 EBRPAR
Leveling from 08/23/87 to 10/17/87
Agency = EGENG    First three states = LA

 SPSN  ACRN  DESIGNATION               SP

@0083 BJ3384 SULLIVAN                       L24804/1      L25082/10
L25082/11    L25082/12
@0084 BJ3383 SULLIVAN RM 2                  L24804/1      L25082/11
L25082/12
@0119 BJ3382 17 V 45                        L24804/1      L25082/12
@0120 BJ3381 17 V 44                        L24804/1      L25082/12
L25082/13
@0161 BJ3380 17 V 43                        L24804/1      L25082/12
@0162 BJ3378 BOLO 3                         L24804/1      L25082/12
@0184 BJ3379 BOLO 3 RM 5                    L24804/1      L25082/12
@0163 BJ3376 17 V 42                        L24804/1      L25082/12
@0325 BJ3915 40 87                     ( 1)  L25082/12
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@0164 BJ3375 17 V 41                        L24804/1      L25082/12
@0159 BJ3374 17 V 40                        L24804/1      L25082/12
L25082/13
@0145 BJ3373 TAYLOR RM 2                    L24804/1      L25082/12
@0144 BJ3372 TAYLOR                    ( 1)  L24804/1      L25082/12
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********************************************************
@0146 BJ4013 C 922 RESET                    L25082/12
@0147 BJ3975 523                            L25082/12     L25082/16
@0148 BJ4107 319                            L25082/12
@0324 BJ3913 41 87                     ( 1)  L25082/12
********************************************************************************
********************************************************
@0149 BJ4012 424                            L25082/12
@0150 BJ4010 609                            L25082/12     L25082/7

@ = navd 88 adjusted mark
M = navd 88 crustal motion height or one mark tie
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NMO L24804/1

SCOTLAND

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS

ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

LINES	O/C	AGENCY	YR
L24804/1	21	LADTD	1983
L25082/12	22	EGENG	1987

THE FOLLOWING DATA ARE FOR THE BASE LINE L24804/1

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
BJ0506	510	C	18.70270	0.00	0
BJ0507	Y 284	C	17.00172	1.18	0
BJ0508	Z 284	C	16.76759	1.39	0
BJ0531	A 287 RESET 1978	C	19.06495	1.96	0
BJ3370	17 V 39 1983 LADH	C	20.03880	3.36	0
BJ3371	TAYLOR RM 1	C	20.44548	4.08	0
BJ3372	TAYLOR	C	20.42919	4.10	0
BJ3373	TAYLOR RM 2	C	20.45068	4.11	0
BJ3374	17 V 40	C	18.92233	5.70	0
BJ3375	17 V 41	C	17.41767	7.65	0
BJ3376	17 V 42	C	16.70684	8.71	0
BJ3377	BOLO 2 RM 4	C	19.09680	10.06	0
BJ3378	BOLO 3	C	18.84351	10.09	0
BJ3379	BOLO 3 RM 5	C	18.90337	10.14	0
BJ3380	17 V 43	C	18.36274	11.89	0
BJ3381	17 V 44	C	19.03438	13.66	0
BJ3382	17 V 45	C	20.43583	15.19	0
BJ3383	SULLIVAN RM 2	C	19.54583	16.11	0
BJ3384	SULLIVAN	C	19.37407	16.15	0
BJ3385	SULLIVAN RM 1	C	19.49279	16.19	0
BJ3386	SULLIVAN AZ MK	C	20.02956	16.54	0
BJ3387	17 V 46	C	22.24623	18.39	0
BJ3388	17 V 9	C	23.88313	20.31	0
BJ3389	17 V 10	C	23.35197	22.08	1
BJ3390	DYER RM 1	C	22.80374	23.96	1
BJ3391	DYER	C	22.67725	23.99	1
BJ3392	DYER RM 2	C	22.76465	24.02	1
BJ3393	17 V 11 LADH	C	24.81675	21.90	0
BJ3394	17 V 12 LADH	C	26.70674	23.68	0
BJ3395	17 V 13	C	28.16547	25.33	0
BJ3396	17 V 14	C	27.08733	26.55	0

SCOTLAND

ACRN	DESIGNATION AND	STABILITY	HEIGHT (m)	DIST (Km)	SPUR LEVEL
BJ3397	DEERFORD AZ MK	C	29.07103	28.22	1
BJ3398	DEERFORD RM 3	C	29.89345	28.90	1
BJ3399	DEERFORD	C	30.97674	28.93	1
BJ3400	DEERFORD RM 2	C	31.16578	28.97	1
BJ3401	17 V 15	C	26.82740	28.25	0
BJ3402	17 V 16	C	27.99744	30.23	0
BJ3403	17 R 005	C	27.18525	30.96	1
BJ3404	17 R 006	C	25.81377	31.72	1
BJ3405	FLORIDA RM 1	D	25.65943	32.68	1
BJ3406	FLORIDA	C	25.52074	32.70	1
BJ3407	FLORIDA RM 2	C	25.53309	32.73	1
BJ3408	17 V 17 LADH	C	28.45397	31.75	0
BJ3409	17 V 18 LADH	C	30.10329	33.35	0
BJ3410	17 V 19 LADH	C	28.04597	34.63	0
BJ0483	A 912	C	31.32564	35.36	0
BJ0482	17 T 006	C	31.17840	35.59	1
BJ0481	J 219	C	30.20477	36.31	1
BJ0484	ZACHARY	C	31.77729	35.63	0
BJ0485	ZACHARY RM 4	C	31.98591	35.64	0
BJ0486	ZACHARY RM 3	C	31.97854	35.65	0
BJ0487	552	C	31.76728	35.66	0

SCOTLAND

Each of the level lines listed below has bench marks common to the base line L24804/1
and the first common mark is considered equivalent to the elevation of the base line.
Therefore the difference is 0.00. Each subsequent common mark is the difference of the elevation from the first common mark, minus the equivalent difference on the base line, in millimeters.

DESIGNATION AND	STABILITY	DIST	L25082/12
TAYLOR	C	4.10	0.00
TAYLOR RM 2	C	4.11	0.60
17 V 40	C	5.70	-17.24
17 V 41	C	7.65	-25.31
17 V 42	C	8.71	-25.63
BOLO 3	C	10.09	-27.38
BOLO 3 RM 5	C	10.14	-23.14
17 V 43	C	11.89	-18.57
17 V 44	C	13.66	-19.02
17 V 45	C	15.19	-18.70
SULLIVAN RM 2	C	16.11	-9.43
SULLIVAN			

PHASE I DATA FOR ALL NMO'S USED

UNADJUSTED DATA LINE NO.:
L25082/18

ORDER/CLASS = 2/2

PROJECT TITLE: VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
FROM E 22 VIA G 287 AND WEST RAIL TO 409 73
AGENCY:EGENG STATES: LA LEVELING BEGAN 09/05/1987 AND ENDED 10/11/1987 TOL = .033FT X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 15.875 METERS FOR: E 22
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY	SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
0191	BJ0866	E 22	C	0.00	15.87490		30 28 21 N	091 03 28 W
0190	BJ0865	G 287	C	0.97	15.32259	1	30 28 20 N	091 04 00 W
0189	BJ3916	MONTERREY	C	2.77	15.76132	1	30 28 13 N	091 05 08 W
0188	BJ0863	U 216	B	4.26	16.22810	1	30 28 15 N	091 06 02 W
0187	BJ0862	T 216	C	5.79	17.02936	1	30 28 16 N	091 06 57 W
0294	BJ4062	WEST RAIL	D	6.52	22.31665	1	30 28 34 N	091 06 47 W
0295	BJ4061	EAST RAIL	D	6.58	22.31725	1	30 28 34 N	091 06 47 W
0296	BJ4079	WARD	C	6.60	20.51244	1	30 28 36 N	091 06 44 W
0297	BJ3996	JOYCE	D	8.26	16.26931	1	30 28 56 N	091 05 44 W
0298	BJ3995	A 919	C	9.35	16.48763	1	30 29 03 N	091 05 09 W
0300	BJ4077	26 87	C	10.68	13.97299	1	30 29 29 N	091 05 19 W
0124	BJ4088	409	C	12.11	16.13487	1	30 30 14 N	091 05 10 W

UNADJUSTED DATA LINE NO.:
L25082/17

ORDER/CLASS = 2/2

PROJECT TITLE: VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
FROM 17 V 39 VIA 506 AND T 216 TO 17 V 39
AGENCY:EGENG STATES: LA LEVELING BEGAN 08/28/1987 AND ENDED 10/10/1987 TOL = .033FT X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 20.358 METERS FOR: 17 V 39

AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY		SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
0131	BJ3515	17 V 39	C		0.00	20.35790		30 30 30 N	091 10 16 W
0132	BJ3516	506	C		0.89	16.11969	1	30 30 01 N	091 10 13 W
0133	BJ3896	EXXON AZ MK	D		1.84	18.15798	1	30 29 32 N	091 10 09 W
0165	BJ0520	H 287	C	1	2.21	17.50098	2	30 29 32 N	091 10 19 W
0166	BJ3894	EXXON	C	1	2.27	17.85476	2	30 29 32 N	091 10 19 W
0167	BJ0522	EB 946	A	1	2.29	18.40188	2	30 29 32 N	091 10 19 W
0168	BJ0523	EB 945	A	1	2.31	18.47155	2	30 29 32 N	091 10 19 W
0169	BJ0521	EB 944	A	1	2.33	18.29217	2	30 29 32 N	091 10 19 W
0133	BJ3896	EXXON AZ MK	D	*	1.84	18.15798		30 29 32 N	091 10 09 W
0134	BJ4073	CHIPPEWA	D		3.99	18.24690	2	30 28 33 N	091 10 08 W
0228	BJ0859	D 287	B		4.52	19.50442	1	30 28 10 N	091 09 59 W
0185	BJ0860	E 287	C		6.15	15.30453	1	30 28 12 N	091 08 59 W
0186	BJ0861	F 287	B		7.78	16.51462	1	30 28 14 N	091 08 01 W
0187	BJ0862	T 216	C		9.60	17.08673	1	30 28 16 N	091 06 57 W
0305	BJ4063	27 87	C		11.06	15.99279	1	30 28 53 N	091 07 00 W
0304	BJ4064	28 87	C		12.44	15.94432	1	30 29 32 N	091 07 32 W
0303	BJ4065	29 87	C		13.59	17.45804	1	30 30 05 N	091 07 57 W
0302	BJ4066	30 87	C		15.08	17.06659	1	30 30 29 N	091 08 48 W
0301	BJ4067	33 87	C		16.63	16.82371	1	30 30 30 N	091 09 54 W
0131	BJ3515	17 V 39	C	1	17.75	20.35629	1	30 30 30 N	091 10 16 W

UNADJUSTED DATA LINE NO.:
L25082/23

ORDER/CLASS = 2/2

PROJECT TITLE: VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
FROM T 216 VIA 17 TO A 3045 A
AGENCY:EGENG STATES: LA LEVELING BEGAN 09/11/1987 AND ENDED 10/17/1987 TOL = .033FT X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 17.044 METERS FOR: T 216
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY	SPUR LEVEL	DIST	UNADJUSTED HEIGHT	NO. OF	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE

SPSN	ACRN	DESIGNATION AND STABILITY		SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
0187	BJ0862	T 216	C		0.00	17.04360		30 28 16 N	091 06 57 W
0229	BJ0987	17	C		0.78	15.60484	1	30 27 50 N	091 06 44 W
0230	BJ0985	A 3045 A	C		2.75	14.82479	2	30 27 03 N	091 06 08 W

UNADJUSTED DATA LINE NO.:
L25082/12

ORDER/CLASS = 2/2

PROJECT TITLE: VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
SULLIVAN VIA 17 V 45 LADH, 17 V 42 LADH, TAYLOR LADH, TO 609 73 EBRPAR
AGENCY:EGENG STATES: LA LEVELING BEGAN 08/23/1987 AND ENDED 10/17/1987 TOL = .033FT X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 19.500 METERS FOR: SULLIVAN
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY		SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
0083	BJ3384	SULLIVAN	C		0.00	19.50000		30 33 31 N	091 02 22 W
0084	BJ3383	SULLIVAN RM 2	C		0.04	19.67189	1	30 33 33 N	091 02 23 W
0119	BJ3382	17 V 45	C		1.00	20.55262	1	30 33 38 N	091 02 52 W
0120	BJ3381	17 V 44	C		2.57	19.15084	1	30 32 51 N	091 03 13 W
0161	BJ3380	17 V 43	C		4.37	18.47965	1	30 32 24 N	091 04 06 W
0162	BJ3378	BOLO 3	C		6.22	18.95161	1	30 32 00 N	091 05 08 W
0184	BJ3379	BOLO 3 RM 5	C		6.27	19.01571	1	30 31 59 N	091 05 08 W
0163	BJ3376	17 V 42	C		7.63	16.81670	1	30 31 50 N	091 05 50 W
0325	BJ3915	40 87	D	1	8.05	18.70772	2	30 31 50 N	091 05 35 W
0163	BJ3376	17 V 42	C	*	7.63	16.81670		30 31 50 N	091 05 50 W
0164	BJ3375	17 V 41	C		8.88	17.52785	1	30 31 47 N	091 06 28 W
0159	BJ3374	17 V 40	C		10.92	19.04057	1	30 31 32 N	091 07 38 W
0145	BJ3373	TAYLOR RM 2	C		12.48	20.58677	1	30 31 28 N	091 08 34 W
0144	BJ3372	TAYLOR	C	1	12.51	20.56468	2	30 31 27 N	091 08 33 W
0145	BJ3373	TAYLOR RM 2	C	*	12.48	20.58677		30 31 28 N	091 08 34 W
0146	BJ4013	C 922 RESET	C		13.86	20.05684	1	30 31 57 N	091 08 30 W
0147	BJ3975	523	C		15.71	20.12607	1	30 32 27 N	091 08 42 W
0148	BJ4107	319	C		17.30	17.23096	1	30 32 48 N	091 08 13 W
0324	BJ3913	41 87	B	1	17.90	19.10903	2	30 32 30 N	091 08 13 W

0148	BJ4107	319	C	*	17.30	17.23096		30 32 48 N	091 08 13 W
0149	BJ4012	424	C		17.74	17.94461	1	30 33 04 N	091 08 10 W
0150	BJ4010	609	C		19.27	20.36841	1	30 33 28 N	091 08 28 W

UNADJUSTED DATA RELEVELING LINE NO.:
L24133/16

ORDER/CLASS = 1/1

PROJECT TITLE: NEW ORLEANS DISTRICT CORPS OF ENGINEERS LEVELING
BATON ROUGE TO HAMMOND LA
AGENCY:NGS STATES: LA LEVELING BEGAN 09/16/1976 AND ENDED 10/29/1976 TOL = 3.0 MM X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 16.318 METERS FOR: Q 287
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY	SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
1002	BJ0555	Q 287 B		0.00	16.31800		30 28 05 N	091 11 19 W
0570	BJ0858	C 287 C		1.30	17.74455	2	30 28 09 N	091 10 31 W
0571	BJ0859	D 287 B		2.13	19.40722	2	30 28 10 N	091 09 59 W
0572	BJ0860	E 287 C		3.76	15.22358	2	30 28 12 N	091 08 59 W
0573	BJ0861	F 287 B		5.26	16.46756	2	30 28 14 N	091 08 01 W
0574	BJ0862	T 216 C		6.99	17.04287	2	30 28 16 N	091 06 57 W
7025	AK8410	TBM 7025		7.67	17.72829	2	30 28 16 N	091 06 32 W
0575	BJ0863	U 216 B		8.50	16.23150	2	30 28 15 N	091 06 02 W
0576	BJ0864	V 216 C		10.05	15.57481	2	30 28 17 N	091 05 04 W
0577	BJ0865	G 287 C		11.79	15.32731	3	30 28 20 N	091 04 00 W
7024	AK8411	TBM 7024		12.29	15.13788	2	30 28 21 N	091 03 42 W
0578	BJ0866	E 22 C		12.65	15.87417	2	30 28 21 N	091 03 28 W
0579	BJ0867	X 216 C		13.83	14.82228	2	30 28 22 N	091 02 46 W
0580	BJ0868	R 287 B		15.18	13.32834	2	30 28 28 N	091 01 56 W
0581	BJ0869	S 286 B		16.67	12.95909	2	30 27 45 N	091 02 10 W
0582	BJ0870	17 K 004 C		18.14	13.70551	2	30 27 53 N	091 01 15 W
0583	BJ0871	R 286 D		19.19	13.36171	2	30 28 00 N	091 00 36 W
0584	BJ0872	17 K 006 C		20.08	12.65181	3	30 28 03 N	091 00 02 W
0585	BJ0873	STEVENS RESET C		20.86	11.94732	2	30 27 57 N	090 59 28 W
0586	BJ0874	STEVENS RM 3 C		20.87	11.40121	2	30 27 58 N	090 59 35 W
0587	BJ0875	Q 286 B		21.07	13.16488	2	30 27 53 N	090 59 28 W

7023	AK8412	TBM 7023			21.51	12.81590	2	30 27 50 N	090 59 12 W
0588	BJ0876	P 286	B		21.91	12.21904	2	30 27 48 N	090 58 58 W
0589	BJ0877	M 286	D		23.57	11.74921	2	30 28 06 N	090 58 02 W
0590	BJ0878	N 286	C		24.53	12.12365	2	30 28 31 N	090 57 40 W
0591	BJ0879	P 294	B		25.70	15.20228	2	30 29 02 N	090 57 22 W
0592	BJ0880	B 22	D	1	25.83	15.35755	2	30 29 06 N	090 57 24 W
0591	BJ0879	P 294	B	*	25.70	15.20228		30 29 02 N	090 57 22 W
0593	BJ0881	X 287	C		26.93	13.09911	2	30 29 07 N	090 56 36 W
0594	BJ0882	Y 287	C		28.60	14.07268	2	30 29 16 N	090 55 34 W
0595	BJ0883	TT 7 L USGS	C		29.69	13.61906	2	30 29 21 N	090 54 55 W
0596	BJ0884	Z 287	C		30.71	12.93756	2	30 29 24 N	090 54 17 W
0597	BJ0885	L 286	C		32.36	13.70274	2	30 29 32 N	090 53 18 W
0598	BJ0886	Q 294	B		33.76	13.53969	2	30 29 19 N	090 52 27 W
0599	BJ0887	W 286	B		34.86	14.24270	2	30 29 21 N	090 51 48 W
0642	BJ0888	T 286	D		35.34	13.55527	2	30 29 19 N	090 51 31 W
0643	BJ0889	U 286	C		36.33	13.59838	2	30 29 34 N	090 50 56 W
0644	BJ0890	V 286	B		37.19	14.87094	2	30 29 46 N	090 50 26 W
0645	BJ0891	X 286	D		38.81	14.34585	2	30 30 00 N	090 49 27 W
0646	BJ0892	Y 286	D		40.05	14.39964	3	30 30 06 N	090 48 42 W
0647	BJ0893	TT 9 L USGS	C		41.08	13.42644	2	30 30 11 N	090 48 06 W
0648	BJ0894	R 294	B		41.12	13.58144	2	30 30 11 N	090 48 06 W
0649	BJ0895	B 290	D		42.06	12.98271	2	30 30 10 N	090 47 28 W
0650	BJ0896	A 290	D		42.86	12.86031	2	30 30 09 N	090 46 59 W
0651	BJ0897	Y 21	D		44.22	12.60423	2	30 30 11 N	090 46 08 W
7026	AK8413	TBM 7026			45.48	12.20284	2	30 30 15 N	090 45 20 W
0653	BJ0898	S 294	B		46.33	12.94748	2	30 30 17 N	090 44 48 W
0654	BJ0899	C 290	D		46.65	13.59721	2	30 30 12 N	090 44 37 W
0655	BJ0900	D 290	D		47.72	12.58057	2	30 30 10 N	090 43 54 W
0656	BJ0901	E 290	B		49.17	11.05422	2	30 30 10 N	090 43 00 W
0657	BJ0902	F 290	B		50.29	10.88858	2	30 30 11 N	090 42 18 W
0658	BJ0903	H 290	D		51.50	11.47867	2	30 30 12 N	090 41 30 W
0659	BJ0904	G 290	B		52.94	12.99871	2	30 30 13 N	090 40 37 W
0660	BJ0905	GAGING STATION USGS	B		52.97	13.00378	2	30 30 12 N	090 40 36 W
0661	BJ0906	T 294	B		53.80	11.52144	2	30 30 14 N	090 40 08 W
0662	BJ0907	J 290	D		54.09	12.13347	2	30 30 12 N	090 39 55 W
0663	BJ0908	K 290	D		55.35	12.48907	2	30 30 12 N	090 39 08 W
0664	BJ0909	ALLEN RM 2	C		56.39	12.68108	2	30 30 14 N	090 38 27 W
0665	BJ0910	ALLEN RM 3	C		56.41	12.71834	2	30 30 14 N	090 38 27 W
0666	BJ0911	ALLEN RESET	C		56.43	12.80432	2	30 30 14 N	090 38 26 W
0667	BJ0912	P 290	D		57.56	13.27475	2	30 30 12 N	090 37 46 W
0668	BJ0913	N 290	D		58.95	13.66822	3	30 30 15 N	090 36 52 W

0669	BJ0914	M 290	B		59.77	13.90382	2	30 30 16 N	090 36 22 W
0670	BJ0915	L 290	D		61.03	12.54978	2	30 30 16 N	090 35 36 W
0671	BJ0916	TT 13 L	C		62.00	12.37411	2	30 30 16 N	090 34 56 W
0672	BJ0917	V 294	B		62.56	10.37115	2	30 30 14 N	090 34 37 W
0673	BJ0918	U 294	B		62.77	11.26045	2	30 30 15 N	090 34 26 W
0674	BJ0919	W 294	C		64.37	10.89455	2	30 30 14 N	090 33 30 W
0675	BJ0920	U 21	C	1	64.44	11.69767	2	30 30 15 N	090 33 31 W
0674	BJ0919	W 294	C	*	64.37	10.89455		30 30 14 N	090 33 30 W
0676	BJ0921	X 294	B		65.62	10.23294	2	30 30 16 N	090 32 43 W
0677	BJ0922	Y 294	D		66.64	12.15735	4	30 30 12 N	090 32 02 W
0678	BJ0923	TT 14 L USGS	C		66.86	12.32401	2	30 30 18 N	090 32 01 W
0679	BJ0924	G 295	C		68.09	11.98600	2	30 30 18 N	090 31 18 W
0680	BJ0925	F 295	B		69.38	12.05410	2	30 30 15 N	090 30 27 W
0681	BJ0926	E 295	B		69.80	13.27811	2	30 30 16 N	090 30 15 W
0682	BJ0927	C 295	D		70.75	11.67033	2	30 30 14 N	090 29 38 W
0683	BJ0928	B 295	B		71.86	11.58915	2	30 30 14 N	090 28 58 W
0684	BJ0929	Z 178	D	1	72.24	12.32537	2	30 30 23 N	090 29 00 W
0683	BJ0928	B 295	B	*	71.86	11.58915		30 30 14 N	090 28 58 W
0685	BJ0930	Y 178	D		72.23	11.67459	2	30 30 16 N	090 28 49 W
0686	BJ0931	D 295	D		73.34	11.41011	2	30 30 20 N	090 28 00 W
0687	BJ0932	Z 294	B		73.91	13.24337	2	30 30 26 N	090 27 46 W
0688	BJ0933	P 19	B		73.99	14.62078	2	30 30 24 N	090 27 44 W
0689	BJ0934	P 275	D	1	74.13	12.87794	2	30 30 28 N	090 27 42 W
0688	BJ0933	P 19	B	*	73.99	14.62078		30 30 24 N	090 27 44 W
0690	BJ0935	TT 16 L RESET	C		74.28	14.20370	2	30 30 14 N	090 27 42 W
0691	BJ0936	1101	C		74.32	12.51970	2	30 30 14 N	090 27 44 W
0692	BJ0937	HAMMOND RESET	C		74.66	13.03936	2	30 30 17 N	090 27 28 W
2999	BJ0940	A 295	B	1	75.11	12.35691	2	30 30 30 N	090 27 28 W
3000	BJ0941	S 21	C	1	76.10	12.13608	2	30 30 36 N	090 26 58 W
0692	BJ0937	HAMMOND RESET	C	*	74.66	13.03936		30 30 17 N	090 27 28 W
0693	BJ0939	TA 268	A		75.56	10.77714	2	30 30 01 N	090 27 40 W
0694	BJ0938	TA 253	A		75.71	10.39681	2	30 29 58 N	090 27 40 W

UNADJUSTED DATA RELEVELING LINE NO.:
L24133/17

ORDER/CLASS = 1/1

PROJECT TITLE: NEW ORLEANS DISTRICT CORPS OF ENGINEERS LEVELING
BATON ROUGE TO 2 MI N OF UNION
AGENCY:NGS STATES: LA LEVELING BEGAN 08/11/1976 AND ENDED 04/28/1977 TOL = 3.0 MM X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 16.318 METERS FOR: Q 287
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY		SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
1002	BJ0555	Q 287	B		0.00	16.31800		30 28 05 N	091 11 19 W
2990	BJ0958	J 22	C		0.22	15.54953	5	30 27 58 N	091 11 21 W
1063	BJ0959	P 296	B		0.84	17.00661	2	30 27 42 N	091 11 13 W
7607	AK8906	TBM 7607			1.21	14.28208	3	30 27 32 N	091 11 12 W
1064	BJ0960	L 22	D		1.47	19.92023	2	30 27 25 N	091 11 12 W
1008	BJ0961	17 B 013	C		1.73	16.10786	2	30 27 22 N	091 11 23 W
1065	BJ0962	C 204	C		2.14	13.27296	2	30 27 09 N	091 11 27 W
7606	AK8907	TBM 7606			2.71	11.74646	2	30 26 52 N	091 11 25 W
1066	BJ0963	B 197 WELL	D	1	2.75	10.50777	2	30 26 51 N	091 11 23 W
7606	AK8907	TBM 7606		*	2.71	11.74646		30 26 52 N	091 11 25 W
1067	BJ0964	2	D		2.84	11.43851	2	30 26 48 N	091 11 24 W
7605	AK8908	TBM 7605		1	2.96	17.37708	2	30 26 48 N	091 11 20 W
1068	BJ0965	XXXI	B	2	3.01	18.54422	2	30 26 48 N	091 11 21 W
7605	AK8908	TBM 7605		*	2.96	17.37708		30 26 48 N	091 11 20 W
1069	BJ0966	NORTH BOULEVARD CAP	D	1	3.17	16.70007	2	30 26 49 N	091 11 13 W
1070	BJ0967	POST OFFICE	B	1	3.20	17.62480	2	30 26 49 N	091 11 13 W
1067	BJ0964	2	D	*	2.84	11.43851		30 26 48 N	091 11 24 W
1071	BJ0968	K 22	D	1	2.95	12.00813	3	30 26 45 N	091 11 25 W
1067	BJ0964	2	D	*	2.84	11.43851		30 26 48 N	091 11 24 W
7604	AK8909	TBM 7604			3.17	9.54203	3	30 26 38 N	091 11 24 W
0631	BJ0969	M 197	C	1	3.95	11.22538	2	30 26 35 N	091 10 55 W
0632	BJ0970	N 197	B	1	4.35	15.05684	2	30 26 36 N	091 10 42 W
0633	BJ0971	P 197	C	1	4.87	17.06767	2	30 26 37 N	091 10 23 W
0634	BJ0972	Q 197	C	1	6.23	13.41981	2	30 26 41 N	091 09 34 W
0635	BJ0973	M 288	C	1	6.88	13.79522	2	30 26 38 N	091 09 11 W
7601	AK8910	TBM 7601		1	7.47	15.70659	2	30 26 40 N	091 08 50 W
0636	BJ0974	R 197 WELL	D	1	7.96	15.53009	2	30 26 41 N	091 08 33 W
7600	AK8911	TBM 7600		1	8.44	16.28803	2	30 26 41 N	091 08 16 W
0637	BJ0975	W 197	D	2	8.79	16.84317	2	30 26 50 N	091 08 16 W
7600	AK8911	TBM 7600		*	8.44	16.28803		30 26 41 N	091 08 16 W
0638	BJ0976	L 288	C	1	9.24	17.06386	2	30 26 40 N	091 07 48 W
0639	BJ0977	N 288	C	1	10.18	16.53358	2	30 26 41 N	091 07 16 W
0640	BJ0978	U 197	D	1	11.17	15.97020	2	30 26 44 N	091 06 39 W

0641	BJ0979	V 197	C	1	11.27	15.65466	2	30 26 48 N	091 06 39 W
1005	BJ0980	DONAIR RM 2	C	1	11.54	15.16077	2	30 26 51 N	091 06 40 W
1006	BJ0981	DONAIR	C	1	11.55	15.08263	2	30 26 56 N	091 06 42 W
1007	BJ0982	DONAIR RM 1	C	1	11.56	15.19287	3	30 26 53 N	091 06 40 W
1012	BJ0983	102 EBRPAR	C	1	11.79	15.27921	2	30 27 00 N	091 06 50 W
1011	BJ0984	DONAIR AZ MK	C	1	12.73	15.21128	2	30 27 03 N	091 06 18 W
1009	BJ0985	A 3045 A	C	1	12.92	14.79382	2	30 27 03 N	091 06 08 W
1010	BJ0986	ROUGE	C	2	13.61	19.67503	2	30 27 10 N	091 05 46 W
1009	BJ0985	A 3045 A	C	*	12.92	14.79382		30 27 03 N	091 06 08 W
7608	AK8912	TBM 7608		1	13.89	14.95015	2	30 27 26 N	091 06 24 W
1013	BJ0987	17	C	1	14.89	15.60428	3	30 27 50 N	091 06 44 W
0574	BJ0862	T 216	C	1	15.55	17.04641	2	30 28 16 N	091 06 57 W
7604	AK8909	TBM 7604		*	3.17	9.54203		30 26 38 N	091 11 24 W
1072	BJ0988	J 288	B		3.76	10.72699	2	30 26 20 N	091 11 24 W
7610	AK8913	TBM 7610			4.27	8.70346	2	30 26 04 N	091 11 25 W
1073	BJ0989	C 198	B	1	5.20	14.59654	2	30 25 55 N	091 11 07 W
7610	AK8913	TBM 7610		*	4.27	8.70346		30 26 04 N	091 11 25 W
1074	BJ0990	K 288	C		4.53	9.88917	2	30 25 56 N	091 11 25 W
1075	BJ0991	D 197	C		5.42	10.93628	3	30 25 30 N	091 11 30 W
1076	BJ0992	C 927 LAGS	C		6.70	7.57856	2	30 24 50 N	091 11 41 W
1077	BJ0993	C 929	C		8.08	7.59583	3	30 24 10 N	091 12 02 W
1078	BJ0994	C 930	C		8.63	7.45662	3	30 23 53 N	091 12 13 W
1079	BJ0995	ARLINGTON CAP RESET	D		8.67	7.51859	3	30 23 53 N	091 12 11 W
1080	BJ0996	B 198	B		10.05	7.46716	5	30 23 17 N	091 12 42 W
1081	BJ0997	W 94 RESET	C		11.71	8.42031	3	30 22 37 N	091 13 24 W
1082	BJ0998	C 936	C		13.04	9.22653	2	30 22 02 N	091 13 52 W
1083	BJ0999	XXV11	C		14.37	9.16909	2	30 21 21 N	091 13 59 W
1084	BJ1000	C 940	C		15.11	11.53978	2	30 21 01 N	091 13 47 W
1085	BJ1001	E 197	C		16.07	8.75665	2	30 21 03 N	091 13 14 W
7404	AK8914	TBM 7404			16.92	8.71514	2	30 21 05 N	091 12 43 W
1086	BJ1002	C 944	C		17.63	12.67568	2	30 21 06 N	091 12 18 W
1088	BJ1003	L 197 RESET	C		19.35	6.65683	2	30 21 13 N	091 11 19 W
1089	BJ1004	K 197 RESET	D		20.80	7.35094	2	30 21 08 N	091 10 22 W
1090	BJ1005	P 288	C		22.23	8.15628	2	30 20 54 N	091 09 31 W
1091	BJ1006	A 198	B		23.65	8.07930	2	30 20 34 N	091 08 43 W
1092	BJ1007	BURTVILLE RM 3	C		25.39	6.70795	2	30 19 54 N	091 08 03 W
1093	BJ1008	BURTVILLE RESET	C		25.43	6.84162	2	30 19 54 N	091 08 03 W
1094	BJ1009	J 197	C		27.25	8.09259	2	30 18 59 N	091 08 17 W
1095	BJ1010	RIVER MISSISSIPPI MP 15	D		27.87	7.33315	3	30 18 46 N	091 08 35 W
1096	BJ1011	H 197	C		28.78	7.25604	2	30 18 34 N	091 09 04 W
1097	BJ1012	RIVER MISSISSIPPI MP 16	D		29.75	7.57935	2	30 18 31 N	091 09 40 W

1098	BJ1013	G 197	C		29.95	7.49263	2	30 18 32 N	091 09 47 W
1099	BJ1014	IB 44	A		31.22	7.09189	2	30 18 33 N	091 10 34 W
1100	BJ1015	PERTUIT	C		32.37	8.21128	2	30 18 40 N	091 11 14 W
1101	BJ1016	Q 288	C		34.03	7.47074	2	30 18 25 N	091 12 12 W
7405	AK8915	TBM 7405			35.66	8.37798	2	30 18 08 N	091 13 09 W
1102	BJ1017	IB 40 USGS	D	1	35.82	8.12462	2	30 18 07 N	091 13 09 W
7405	AK8915	TBM 7405		*	35.66	8.37798		30 18 08 N	091 13 09 W
1103	BJ1018	RIVER MISSISSIPPI MP 20	D		35.97	8.56439	2	30 18 05 N	091 13 20 W
1003	BJ1019	F 197	C		36.27	8.56737	2	30 17 56 N	091 13 23 W
7602	AK8916	TBM 7602		1	37.14	4.92467	2	30 17 37 N	091 13 37 W
7603	AK8917	TBM 7603		1	37.72	6.22679	2	30 17 24 N	091 13 46 W
0547	BJ0579	X 290	B	1	38.00	8.05686	2	30 17 17 N	091 13 51 W
1003	BJ1019	F 197	C	*	36.27	8.56737		30 17 56 N	091 13 23 W
1105	BJ1020	Q 94 RESET	C		37.67	8.33707	2	30 17 23 N	091 12 49 W
1106	BJ1021	178 2 RESET	C		39.10	8.31178	2	30 17 07 N	091 12 01 W
1107	BJ1022	P 94 RESET	C		39.91	8.56242	2	30 17 16 N	091 11 33 W
1108	BJ1023	IB 41 USGS	D		41.56	7.29013	2	30 17 23 N	091 10 33 W
1109	BJ1024	N 94 RESET	C		41.79	7.71441	2	30 17 22 N	091 10 27 W
1110	BJ1025	ANGER RESET	D		42.41	7.73024	2	30 17 23 N	091 10 04 W
1111	BJ1026	R 288	C		43.66	7.13993	2	30 17 13 N	091 09 19 W
1112	BJ1027	IB 47	D		45.00	7.23649	2	30 17 02 N	091 08 33 W
7406	AK8918	TBM 7406			46.11	7.19640	2	30 16 45 N	091 07 57 W
1113	BJ1028	GAGE 32 BOLT	D	1	46.17	6.23394	2	30 16 46 N	091 07 58 W
7406	AK8918	TBM 7406		*	46.11	7.19640		30 16 45 N	091 07 57 W
1475	BJ1029	L 94	C		47.98	6.96923	2	30 16 16 N	091 06 57 W
1476	BJ1030	K 94	C		49.77	6.72578	2	30 15 33 N	091 06 14 W
1404	BJ1031	K 297	B		50.00	7.60782	2	30 15 26 N	091 06 14 W
1478	BJ1032	24 A 001	C	1	50.48	6.22619	2	30 15 27 N	091 05 55 W
1404	BJ1031	K 297	B	*	50.00	7.60782		30 15 26 N	091 06 14 W
1403	BJ1033	RIVER MISSISSIPPI MP 30	C		51.12	5.67879	2	30 14 50 N	091 06 13 W
1405	BJ1034	3004	C		52.34	6.21220	2	30 14 19 N	091 06 41 W
1406	BJ1035	180 B CAP	D		52.60	7.10023	2	30 14 01 N	091 06 44 W
1407	BJ1036	J 94 RESET	C		53.78	7.33312	2	30 13 56 N	091 07 24 W
7407	AK8919	TBM 7407			54.80	6.54917	2	30 13 35 N	091 07 49 W
1408	BJ1037	GAGE 31 CAP	D	1	55.11	6.51804	2	30 13 25 N	091 07 43 W
7407	AK8919	TBM 7407		*	54.80	6.54917		30 13 35 N	091 07 49 W
1409	BJ1038	X 192	C		55.15	7.04608	2	30 13 28 N	091 07 58 W
1410	BJ1039	RIVER MISSISSIPPI MP 33	D		55.97	7.41719	2	30 13 08 N	091 08 19 W
1411	BJ1040	H 94	C		56.64	7.78284	2	30 12 49 N	091 08 36 W
1412	BJ1041	RIVER MISSISSIPPI MP 34	D		57.48	7.16495	2	30 12 26 N	091 08 51 W
1413	BJ1042	W 192	C		57.55	7.39369	2	30 12 23 N	091 08 52 W

1414	BJ1043	RIVER MISSISSIPPI MP 35	D		58.80	7.58005	2	30 11 45 N	091 09 10 W
1415	BJ1044	CURLEY CAP	A	1	59.22	7.37033	2	30 11 46 N	091 08 55 W
1414	BJ1043	RIVER MISSISSIPPI MP 35	D	*	58.80	7.58005		30 11 45 N	091 09 10 W
1416	BJ1045	V 192	C		58.90	7.65574	2	30 11 40 N	091 09 11 W
1417	BJ1046	RIVER MISSISSIPPI MP 36	D		60.27	7.71407	2	30 11 04 N	091 08 52 W
1419	BJ1047	N 297	B		60.60	8.37018	2	30 11 03 N	091 08 40 W
1420	BJ1048	F 94	C		61.94	7.45534	2	30 11 26 N	091 08 00 W
7408	AK8076	TBM 7408			62.84	7.86243	2	30 11 43 N	091 07 35 W
1421	BJ1049	IB 58	D	1	63.16	7.11200	2	30 11 54 N	091 07 31 W
7408	AK8076	TBM 7408		*	62.84	7.86243		30 11 43 N	091 07 35 W
1422	BJ1050	RIVER MISSISSIPPI MP 38	D		63.22	7.55648	2	30 11 50 N	091 07 24 W
1423	BJ1051	U 192	C		63.40	7.43008	2	30 11 57 N	091 07 14 W
1424	BJ1052	E 94	C		64.74	6.91402	2	30 12 22 N	091 06 37 W
1425	BJ1053	RIVER MISSISSIPPI MP 40	D		66.24	6.63978	2	30 12 48 N	091 05 50 W
1426	BJ1054	M 297	B		66.41	7.02720	2	30 12 50 N	091 05 43 W
1427	BJ1055	CARVILLE CAP	D	1	66.79	6.29443	4	30 13 02 N	091 05 48 W
1426	BJ1054	M 297	B	*	66.41	7.02720		30 12 50 N	091 05 43 W
7409	AK8077	TBM 7409			67.27	6.60027	2	30 12 59 N	091 05 13 W
1428	BJ1056	3009	C		67.96	5.75162	2	30 13 06 N	091 04 49 W
1429	BJ1057	3010	C		68.82	5.89032	2	30 13 10 N	091 04 20 W
1430	BJ1058	RIVER MISSISSIPPI MP 42	D		69.37	5.65031	2	30 13 08 N	091 03 58 W
1431	BJ1059	3011	C		69.55	5.56749	2	30 13 06 N	091 03 49 W
2998	BJ1060	RUSSELL CAP	D		70.98	6.26492	2	30 13 00 N	091 03 00 W
7410	AK8078	TBM 7410			71.92	6.40636	2	30 12 52 N	091 02 30 W
1432	BJ1061	R 192	D		72.65	5.20467	2	30 12 46 N	091 02 07 W
1433	BJ1062	3017 RESET	C		74.27	7.39305	2	30 12 10 N	091 01 29 W
1436	BJ1063	GEISMAR RM 6	C	1	74.49	6.88157	2	30 12 11 N	091 01 21 W
1434	BJ1064	GEISMAR	C	1	74.53	6.79557	2	30 12 12 N	091 01 22 W
1435	BJ1065	GEISMAR RM 5	C	1	74.56	7.00953	2	30 12 12 N	091 01 24 W
1437	BJ1066	NEW RIVER CAP	D	1	74.60	7.35535	2	30 12 14 N	091 01 22 W
1438	BJ1067	3 V 13 LADH	C	1	75.88	5.66373	2	30 12 43 N	091 00 49 W
1433	BJ1062	3017 RESET	C	*	74.27	7.39305		30 12 10 N	091 01 29 W
1439	BJ1068	D 94 RESET	C		75.87	6.89690	2	30 11 29 N	091 00 53 W
7411	AK8079	TBM 7411			77.57	7.00798	2	30 10 46 N	091 00 21 W
1441	BJ1069	C 94 RESET	C	1	77.80	7.21510	2	30 10 39 N	091 00 12 W
7411	AK8079	TBM 7411		*	77.57	7.00798		30 10 46 N	091 00 21 W
1442	BJ1070	P 297	A		78.80	7.43313	2	30 10 15 N	090 59 57 W
1444	BJ1071	P 192	C		79.43	7.87868	2	30 09 58 N	090 59 45 W
1445	BJ1072	A 94 RESET	C		80.77	5.83167	2	30 09 13 N	090 59 34 W
7412	AK8080	TBM 7412			81.98	4.66825	2	30 08 42 N	090 59 52 W
7413	AK8081	TBM 7413			83.09	5.46797	2	30 08 13 N	091 00 09 W

1449	BJ1073	L 297	C		84.51	5.50069	2	30 07 36 N	091 00 30 W
1450	BJ1074	187/2 CAP	D		85.62	7.21041	2	30 07 12 N	091 00 48 W
1451	BJ1075	Z 197	B		87.15	6.21385	2	30 07 10 N	090 59 54 W
1452	BJ1076	TT 3 P RESET	C		87.94	6.13758	2	30 07 09 N	090 59 24 W
1453	BJ1077	BRINGIER CAP	D		88.74	6.12389	2	30 07 04 N	090 58 56 W
1454	BJ1078	RIVER MISSISSIPPI MP 56	C		89.94	5.79490	2	30 06 55 N	090 58 15 W
1455	BJ1079	YY 93	C		90.49	6.46715	2	30 06 52 N	090 57 57 W
1456	BJ1080	188/1 CAP	D		92.08	6.35201	2	30 07 12 N	090 57 37 W
1457	BJ1081	XX 93	C		93.55	6.26475	2	30 07 43 N	090 57 10 W
7414	AK8082	TBM 7414			94.78	4.10712	2	30 08 08 N	090 56 48 W
1459	BJ1082	N 192	C		96.44	4.90345	2	30 08 42 N	090 56 19 W
1460	BJ1083	189/1 CAP	D		96.62	4.96464	2	30 08 52 N	090 56 19 W
1461	BJ1084	M 192	C		97.41	5.20954	2	30 08 55 N	090 55 55 W
1462	BJ1085	L 192	C		98.36	5.99249	2	30 08 57 N	090 55 19 W
1463	BJ1086	MILES RM 4	C	1	99.66	3.12328	2	30 09 39 N	090 55 13 W
1465	BJ1087	MILES RM 3	C	1	99.69	3.11381	2	30 09 39 N	090 55 13 W
1462	BJ1085	L 192	C	*	98.36	5.99249		30 08 57 N	090 55 19 W
1466	BJ1088	Q 297	C		99.55	5.78498	2	30 08 19 N	090 55 27 W
1467	BJ1089	K 192 RESET 1965	C		101.04	5.54329	2	30 07 56 N	090 54 31 W
1468	BJ1090	J 192	C		102.58	4.06461	2	30 07 11 N	090 54 12 W
1469	BJ1091	1091 LAGS	C		104.16	4.21341	2	30 06 20 N	090 53 59 W
1471	BJ1092	H 192	B		105.48	6.92198	2	30 05 55 N	090 54 26 W
1473	BJ1093	L 229	B	1	106.41	11.09769	2	30 06 01 N	090 53 57 W
1471	BJ1092	H 192	B	*	105.48	6.92198		30 05 55 N	090 54 26 W
1481	BJ1094	R 297	C		107.28	6.96840	2	30 06 54 N	090 54 42 W
1482	BJ1096	T 297	B	1	108.11	6.95276	2	30 06 50 N	090 55 09 W
1481	BJ1094	R 297	C	*	107.28	6.96840		30 06 54 N	090 54 42 W
1480	BJ1095	S 297	B		107.45	7.23184	2	30 06 55 N	090 54 41 W

UNADJUSTED DATA — LINE NO.: L24813
ORDER/CLASS = 2/1

PROJECT TITLE: BATON ROUGE TO HAMMOND VIA INTERSTATE HIGHWAY 12
AGENCY:LADTD STATES: LA LEVELING BEGAN 11/02/1983 AND ENDED 07/06/1984 TOL = 6.0 MM X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 13.167 METERS FOR: Q 286
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY		SPUR LEVEL	DIST	UNADJUSTED HEIGHT	NO. OF	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE

					(Km)	(m)	RUNS		
1301	BJ0875	Q 286	B		0.00	13.16680		30 27 53 N	090 59 28 W
1302	BJ0874	STEVENS RM 3	C		0.20	11.40625	2	30 27 58 N	090 59 35 W
1303	BJ0873	STEVENS RESET	C		0.21	11.92255	2	30 27 57 N	090 59 28 W
1304	BJ3760	STEVENS RM 2	D		0.25	11.98786	2	30 27 58 N	090 59 35 W
1305	BJ3761	STEVENS AZ MK 2	C		0.58	12.66668	2	30 27 59 N	090 59 47 W
1306	BJ3762	229 AZ MK 2	C		1.89	12.11826	4	30 27 36 N	091 00 28 W
1307	BJ3763	229 73	C		1.95	13.04884	2	30 27 34 N	091 00 30 W
1308	BJ3764	17 D 003	C		3.94	18.26521	2	30 26 32 N	091 00 27 W
1309	BJ3765	17 D 002	C	1	5.63	20.01019	2	30 26 15 N	091 01 27 W
1310	BJ3766	17 D 001	C	1	7.29	12.88886	2	30 26 01 N	091 02 25 W
1311	BJ3767	HARE RM 2	C	1	9.11	13.52582	2	30 25 59 N	091 03 27 W
1312	BJ3768	HARE	C	1	9.12	13.57152	2	30 25 58 N	091 03 26 W
1313	BJ3769	HARE RM 1	C	1	9.13	13.41744	2	30 25 59 N	091 03 27 W
1314	BJ3770	17 C 002	C	1	9.39	13.87829	2	30 25 49 N	091 03 25 W
1315	BJ3771	17 C 001	C	1	10.31	19.67140	2	30 25 38 N	091 03 58 W
1316	BJ3772	LANE RM 1	C	1	11.15	19.49865	2	30 25 27 N	091 04 28 W
1317	BJ3773	LANE	C	1	11.16	19.73639	2	30 25 26 N	091 04 27 W
1318	BJ3774	LANE RM 2	C	1	11.17	19.76456	2	30 25 26 N	091 04 27 W
1308	BJ3764	17 D 003	C	*	3.94	18.26521		30 26 32 N	091 00 27 W
1319	BJ3775	17 D 004	C		5.99	14.25201	2	30 26 49 N	090 59 14 W
1320	BJ3776	17 D 005	C		7.87	17.63442	2	30 27 05 N	090 58 09 W
1321	BJ0877	M 286	D	1	9.99	11.74210	2	30 28 06 N	090 58 02 W
1320	BJ3776	17 D 005	C	*	7.87	17.63442		30 27 05 N	090 58 09 W
1322	BJ3777	DENHAM AZ MK	B		9.18	18.30437	2	30 27 16 N	090 57 21 W
1323	BJ3778	DENHAM RM 3	C		9.70	10.85509	2	30 27 25 N	090 57 03 W
1324	BJ3779	DENHAM	C		9.73	10.99304	2	30 27 23 N	090 57 02 W
1325	BJ3780	DENHAM RM 4	C		9.77	11.31537	2	30 27 25 N	090 57 05 W
1326	BJ3781	32 A 001	C		10.20	18.50887	2	30 27 24 N	090 56 47 W
1327	BJ3782	32 A 002	C		11.51	12.01081	2	30 27 37 N	090 56 01 W
1328	BJ3783	COYEL RM 2	C		13.33	18.44088	2	30 27 55 N	090 54 57 W
1329	BJ3784	COYEL	C		13.34	18.63808	2	30 27 53 N	090 54 56 W
1330	BJ3785	COYEL RM 1	C		13.35	18.92110	2	30 27 55 N	090 54 57 W
1331	BJ3786	COYEL AZ MK	C	1	14.27	11.63482	2	30 27 22 N	090 54 55 W
1330	BJ3785	COYEL RM 1	C	*	13.35	18.92110		30 27 55 N	090 54 57 W
1332	BJ3787	32 B 001	C		15.39	11.84280	2	30 27 58 N	090 53 40 W
1333	BJ3788	32 B 002	C		16.29	10.74865	2	30 27 59 N	090 53 06 W
1334	BJ3789	32 B 003	C		18.62	18.12458	2	30 28 12 N	090 51 46 W
1335	BJ0888	T 286	D	1	20.89	13.53876	2	30 29 19 N	090 51 31 W
1334	BJ3789	32 B 003	C	*	18.62	18.12458		30 28 12 N	090 51 46 W

1336	BJ3790	32 B 004	C		20.34	11.52149	3	30 28 19 N	090 50 44 W
1337	BJ3791	DUMP AZ MK	B		21.24	12.02927	2	30 28 23 N	090 50 10 W
1338	BJ3792	DUMP	C		21.89	10.80331	3	30 28 25 N	090 49 48 W
1339	BJ3793	32 C 001	C		22.90	11.69934	2	30 28 22 N	090 49 11 W
1340	BJ3794	SUMA	C		25.13	17.71168	2	30 28 22 N	090 47 51 W
1341	BJ3795	SUMA AZ MK	C	1	26.31	10.34183	2	30 28 56 N	090 47 38 W
1340	BJ3794	SUMA	C	*	25.13	17.71168		30 28 22 N	090 47 51 W
1342	BJ3796	32 D 001	C		26.75	11.57470	2	30 28 25 N	090 46 51 W
1343	BJ3797	32 V 5	C		28.44	9.50094	2	30 28 27 N	090 45 50 W
1344	BJ3798	32 D 002	C		29.98	17.85811	4	30 28 25 N	090 44 51 W
1345	BJ3799	32 V 1	C	1	31.65	11.88717	2	30 29 20 N	090 44 58 W
1346	BJ0898	S 294	B	1	33.41	12.91826	2	30 30 17 N	090 44 48 W
1344	BJ3798	32 D 002	C	*	29.98	17.85811		30 28 25 N	090 44 51 W
1347	BJ3800	RED OAK AZ MK	C		32.57	10.04335	2	30 28 24 N	090 43 17 W
1348	BJ3801	32 D 003	C		32.75	16.97777	2	30 28 27 N	090 43 23 W
1349	BJ3802	RED OAK RM 2	C		33.06	10.87199	3	30 28 36 N	090 43 33 W
1350	BJ3803	RED OAK	C		33.10	10.56850	3	30 28 34 N	090 43 31 W
1351	BJ3804	RED OAK RM 1	C		33.14	11.03533	2	30 28 35 N	090 43 31 W
1352	BJ3805	32 E 001	C		34.41	9.25120	2	30 28 33 N	090 42 45 W
1353	BJ3806	32 E 002	C		35.49	11.70092	2	30 28 32 N	090 42 04 W
1354	BJ3807	32 E 003	C		37.13	9.98680	2	30 28 29 N	090 41 03 W
1355	BJ3808	32 E 004	C		38.73	10.83004	2	30 28 26 N	090 40 03 W
1356	BJ3809	CAT AZ MK	C		40.78	9.65578	2	30 28 29 N	090 38 47 W
1357	BJ3810	32 V 2	C	1	42.39	9.55375	2	30 29 03 N	090 39 06 W
1358	BJ3811	32 V 3	C	1	44.07	11.06993	2	30 29 42 N	090 39 49 W
1359	BJ0906	T 294	B	1	45.14	11.49071	2	30 30 14 N	090 40 08 W
1356	BJ3809	CAT AZ MK	C	*	40.78	9.65578		30 28 29 N	090 38 47 W
1360	BJ3812	32 E 005	C		41.21	16.98299	2	30 28 27 N	090 38 33 W
1361	BJ3813	CAT	C		41.55	9.88610	2	30 28 16 N	090 38 32 W
1362	BJ3814	32 F 001	C		43.68	11.06001	2	30 28 28 N	090 37 18 W
1363	BJ3815	32 F 002	C		45.55	10.31944	2	30 28 31 N	090 36 08 W
1364	BJ3816	32 F 003	C		47.88	17.38222	2	30 28 40 N	090 34 43 W
1365	BJ3817	32 V 4	C	1	49.38	11.15095	2	30 29 25 N	090 34 57 W
1366	BJ0916	TT 13 L	C	1	50.87	12.33872	2	30 30 16 N	090 34 56 W
1364	BJ3816	32 F 003	C	*	47.88	17.38222		30 28 40 N	090 34 43 W
1367	BJ3818	32 V 6	B		49.87	8.87002	2	30 28 43 N	090 33 30 W
1368	BJ3819	32 F 004	C		51.47	16.80166	2	30 28 45 N	090 32 32 W
1369	BJ3820	32 F 005	C		53.49	10.68026	2	30 28 46 N	090 31 17 W
1370	BJ3821	32 F 006	C		55.61	17.09590	2	30 28 45 N	090 30 02 W
1371	BJ3822	32 F 007	C		56.98	16.16642	3	30 28 43 N	090 29 18 W
1372	BJ3823	32 F 008	C		58.71	17.68142	2	30 29 27 N	090 29 53 W

1373	BJ3824	32 F 009	C		59.80	12.57236	2	30 29 56 N	090 30 12 W
1374	BJ0925	F 295	B		60.65	12.01816	2	30 30 15 N	090 30 27 W
1375	BJ0926	E 295	B	1	61.07	13.22649	2	30 30 16 N	090 30 15 W
1374	BJ0925	F 295	B	*	60.65	12.01816		30 30 15 N	090 30 27 W
1376	BJ0924	G 295	C		61.94	11.95440	2	30 30 18 N	090 31 18 W

UNADJUSTED DATA
L25082/18

LINE NO.:

ORDER/CLASS = 2/2

PROJECT TITLE: VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
FROM E 22 VIA G 287 AND WEST RAIL TO 409 73

AGENCY:EGENG STATES: LA LEVELING BEGAN 09/05/1987 AND ENDED 10/11/1987 TOL = .033FT X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 15.875 METERS FOR: E 22
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY	SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
0191	BJ0866	E 22	C	0.00	15.87490		30 28 21 N	091 03 28 W
0190	BJ0865	G 287	C	0.97	15.32259	1	30 28 20 N	091 04 00 W
0189	BJ3916	MONTERREY	C	2.77	15.76132	1	30 28 13 N	091 05 08 W
0188	BJ0863	U 216	B	4.26	16.22810	1	30 28 15 N	091 06 02 W
0187	BJ0862	T 216	C	5.79	17.02936	1	30 28 16 N	091 06 57 W
0294	BJ4062	WEST RAIL	D	6.52	22.31665	1	30 28 34 N	091 06 47 W
0295	BJ4061	EAST RAIL	D	6.58	22.31725	1	30 28 34 N	091 06 47 W
0296	BJ4079	WARD	C	6.60	20.51244	1	30 28 36 N	091 06 44 W
0297	BJ3996	JOYCE	D	8.26	16.26931	1	30 28 56 N	091 05 44 W
0298	BJ3995	A 919	C	9.35	16.48763	1	30 29 03 N	091 05 09 W
0300	BJ4077	26 87	C	10.68	13.97299	1	30 29 29 N	091 05 19 W
0124	BJ4088	409	C	12.11	16.13487	1	30 30 14 N	091 05 10 W

UNADJUSTED DATA
L25082/17

LINE NO.:

ORDER/CLASS = 2/2

PROJECT TITLE: VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
FROM 17 V 39 VIA 506 AND T 216 TO 17 V 39

AGENCY:EGENG STATES: LA LEVELING BEGAN 08/28/1987 AND ENDED 10/10/1987 TOL = .033FT X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 20.358 METERS FOR: 17 V 39
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY		SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
0131	BJ3515	17 V 39	C		0.00	20.35790		30 30 30 N	091 10 16 W
0132	BJ3516	506	C		0.89	16.11969	1	30 30 01 N	091 10 13 W
0133	BJ3896	EXXON AZ MK	D		1.84	18.15798	1	30 29 32 N	091 10 09 W
0165	BJ0520	H 287	C	1	2.21	17.50098	2	30 29 32 N	091 10 19 W
0166	BJ3894	EXXON	C	1	2.27	17.85476	2	30 29 32 N	091 10 19 W
0167	BJ0522	EB 946	A	1	2.29	18.40188	2	30 29 32 N	091 10 19 W
0168	BJ0523	EB 945	A	1	2.31	18.47155	2	30 29 32 N	091 10 19 W
0169	BJ0521	EB 944	A	1	2.33	18.29217	2	30 29 32 N	091 10 19 W
0133	BJ3896	EXXON AZ MK	D	*	1.84	18.15798		30 29 32 N	091 10 09 W
0134	BJ4073	CHIPPEWA	D		3.99	18.24690	2	30 28 33 N	091 10 08 W
0228	BJ0859	D 287	B		4.52	19.50442	1	30 28 10 N	091 09 59 W
0185	BJ0860	E 287	C		6.15	15.30453	1	30 28 12 N	091 08 59 W
0186	BJ0861	F 287	B		7.78	16.51462	1	30 28 14 N	091 08 01 W
0187	BJ0862	T 216	C		9.60	17.08673	1	30 28 16 N	091 06 57 W
0305	BJ4063	27 87	C		11.06	15.99279	1	30 28 53 N	091 07 00 W
0304	BJ4064	28 87	C		12.44	15.94432	1	30 29 32 N	091 07 32 W
0303	BJ4065	29 87	C		13.59	17.45804	1	30 30 05 N	091 07 57 W
0302	BJ4066	30 87	C		15.08	17.06659	1	30 30 29 N	091 08 48 W
0301	BJ4067	33 87	C		16.63	16.82371	1	30 30 30 N	091 09 54 W
0131	BJ3515	17 V 39	C	1	17.75	20.35629	1	30 30 30 N	091 10 16 W

UNADJUSTED DATA LINE NO.:
L25082/23

ORDER/CLASS = 2/2

PROJECT TITLE: VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
FROM T 216 VIA 17 TO A 3045 A
AGENCY:EGENG STATES: LA LEVELING BEGAN 09/11/1987 AND ENDED 10/17/1987 TOL = .033FT X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 17.044 METERS FOR: T 216
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY	SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE

0187	BJ0862	T 216	C		0.00	17.04360		30 28 16 N	091 06 57 W
0229	BJ0987	17	C		0.78	15.60484	1	30 27 50 N	091 06 44 W
0230	BJ0985	A 3045 A	C		2.75	14.82479	2	30 27 03 N	091 06 08 W

UNADJUSTED DATA LINE NO.:
L25082/12

ORDER/CLASS = 2/2

PROJECT TITLE: VERTICAL CONTROL DENSIFICATION IN EAST BATON ROUGE PARISH LA
SULLIVAN VIA 17 V 45 LADH, 17 V 42 LADH, TAYLOR LADH, TO 609 73 EBRPAR
AGENCY:EGENG STATES: LA LEVELING BEGAN 08/23/1987 AND ENDED 10/17/1987 TOL = .033FT X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 19.500 METERS FOR: SULLIVAN
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND	STABILITY	SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
0083	BJ3384	SULLIVAN	C		0.00	19.50000		30 33 31 N	091 02 22 W
0084	BJ3383	SULLIVAN RM 2	C		0.04	19.67189	1	30 33 33 N	091 02 23 W
0119	BJ3382	17 V 45	C		1.00	20.55262	1	30 33 38 N	091 02 52 W
0120	BJ3381	17 V 44	C		2.57	19.15084	1	30 32 51 N	091 03 13 W
0161	BJ3380	17 V 43	C		4.37	18.47965	1	30 32 24 N	091 04 06 W
0162	BJ3378	BOLO 3	C		6.22	18.95161	1	30 32 00 N	091 05 08 W
0184	BJ3379	BOLO 3 RM 5	C		6.27	19.01571	1	30 31 59 N	091 05 08 W
0163	BJ3376	17 V 42	C		7.63	16.81670	1	30 31 50 N	091 05 50 W
0325	BJ3915	40 87	D	1	8.05	18.70772	2	30 31 50 N	091 05 35 W
0163	BJ3376	17 V 42	C	*	7.63	16.81670		30 31 50 N	091 05 50 W
0164	BJ3375	17 V 41	C		8.88	17.52785	1	30 31 47 N	091 06 28 W
0159	BJ3374	17 V 40	C		10.92	19.04057	1	30 31 32 N	091 07 38 W
0145	BJ3373	TAYLOR RM 2	C		12.48	20.58677	1	30 31 28 N	091 08 34 W
0144	BJ3372	TAYLOR	C	1	12.51	20.56468	2	30 31 27 N	091 08 33 W
0145	BJ3373	TAYLOR RM 2	C	*	12.48	20.58677		30 31 28 N	091 08 34 W
0146	BJ4013	C 922 RESET	C		13.86	20.05684	1	30 31 57 N	091 08 30 W
0147	BJ3975	523	C		15.71	20.12607	1	30 32 27 N	091 08 42 W
0148	BJ4107	319	C		17.30	17.23096	1	30 32 48 N	091 08 13 W
0324	BJ3913	41 87	B	1	17.90	19.10903	2	30 32 30 N	091 08 13 W
0148	BJ4107	319	C	*	17.30	17.23096		30 32 48 N	091 08 13 W

0149	BJ4012	424	C	17.74	17.94461	1	30 33 04 N	091 08 10 W
0150	BJ4010	609	C	19.27	20.36841	1	30 33 28 N	091 08 28 W

UNADJUSTED DATA RELEVELING LINE NO.:
L24133/16

ORDER/CLASS = 1/1

PROJECT TITLE: NEW ORLEANS DISTRICT CORPS OF ENGINEERS LEVELING
BATON ROUGE TO HAMMOND LA
AGENCY:NGS STATES: LA LEVELING BEGAN 09/16/1976 AND ENDED 10/29/1976 TOL = 3.0 MM X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 16.318 METERS FOR: Q 287
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY	SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
1002	BJ0555	Q 287	B	0.00	16.31800		30 28 05 N	091 11 19 W
0570	BJ0858	C 287	C	1.30	17.74455	2	30 28 09 N	091 10 31 W
0571	BJ0859	D 287	B	2.13	19.40722	2	30 28 10 N	091 09 59 W
0572	BJ0860	E 287	C	3.76	15.22358	2	30 28 12 N	091 08 59 W
0573	BJ0861	F 287	B	5.26	16.46756	2	30 28 14 N	091 08 01 W
0574	BJ0862	T 216	C	6.99	17.04287	2	30 28 16 N	091 06 57 W
7025	AK8410	TBM 7025		7.67	17.72829	2	30 28 16 N	091 06 32 W
0575	BJ0863	U 216	B	8.50	16.23150	2	30 28 15 N	091 06 02 W
0576	BJ0864	V 216	C	10.05	15.57481	2	30 28 17 N	091 05 04 W
0577	BJ0865	G 287	C	11.79	15.32731	3	30 28 20 N	091 04 00 W
7024	AK8411	TBM 7024		12.29	15.13788	2	30 28 21 N	091 03 42 W
0578	BJ0866	E 22	C	12.65	15.87417	2	30 28 21 N	091 03 28 W
0579	BJ0867	X 216	C	13.83	14.82228	2	30 28 22 N	091 02 46 W
0580	BJ0868	R 287	B	15.18	13.32834	2	30 28 28 N	091 01 56 W
0581	BJ0869	S 286	B	16.67	12.95909	2	30 27 45 N	091 02 10 W
0582	BJ0870	17 K 004	C	18.14	13.70551	2	30 27 53 N	091 01 15 W
0583	BJ0871	R 286	D	19.19	13.36171	2	30 28 00 N	091 00 36 W
0584	BJ0872	17 K 006	C	20.08	12.65181	3	30 28 03 N	091 00 02 W
0585	BJ0873	STEVENS RESET	C	20.86	11.94732	2	30 27 57 N	090 59 28 W
0586	BJ0874	STEVENS RM 3	C	20.87	11.40121	2	30 27 58 N	090 59 35 W
0587	BJ0875	Q 286	B	21.07	13.16488	2	30 27 53 N	090 59 28 W
7023	AK8412	TBM 7023		21.51	12.81590	2	30 27 50 N	090 59 12 W

0588	BJ0876	P 286	B		21.91	12.21904	2	30 27 48 N	090 58 58 W
0589	BJ0877	M 286	D		23.57	11.74921	2	30 28 06 N	090 58 02 W
0590	BJ0878	N 286	C		24.53	12.12365	2	30 28 31 N	090 57 40 W
0591	BJ0879	P 294	B		25.70	15.20228	2	30 29 02 N	090 57 22 W
0592	BJ0880	B 22	D	1	25.83	15.35755	2	30 29 06 N	090 57 24 W
0591	BJ0879	P 294	B	*	25.70	15.20228		30 29 02 N	090 57 22 W
0593	BJ0881	X 287	C		26.93	13.09911	2	30 29 07 N	090 56 36 W
0594	BJ0882	Y 287	C		28.60	14.07268	2	30 29 16 N	090 55 34 W
0595	BJ0883	TT 7 L USGS	C		29.69	13.61906	2	30 29 21 N	090 54 55 W
0596	BJ0884	Z 287	C		30.71	12.93756	2	30 29 24 N	090 54 17 W
0597	BJ0885	L 286	C		32.36	13.70274	2	30 29 32 N	090 53 18 W
0598	BJ0886	Q 294	B		33.76	13.53969	2	30 29 19 N	090 52 27 W
0599	BJ0887	W 286	B		34.86	14.24270	2	30 29 21 N	090 51 48 W
0642	BJ0888	T 286	D		35.34	13.55527	2	30 29 19 N	090 51 31 W
0643	BJ0889	U 286	C		36.33	13.59838	2	30 29 34 N	090 50 56 W
0644	BJ0890	V 286	B		37.19	14.87094	2	30 29 46 N	090 50 26 W
0645	BJ0891	X 286	D		38.81	14.34585	2	30 30 00 N	090 49 27 W
0646	BJ0892	Y 286	D		40.05	14.39964	3	30 30 06 N	090 48 42 W
0647	BJ0893	TT 9 L USGS	C		41.08	13.42644	2	30 30 11 N	090 48 06 W
0648	BJ0894	R 294	B		41.12	13.58144	2	30 30 11 N	090 48 06 W
0649	BJ0895	B 290	D		42.06	12.98271	2	30 30 10 N	090 47 28 W
0650	BJ0896	A 290	D		42.86	12.86031	2	30 30 09 N	090 46 59 W
0651	BJ0897	Y 21	D		44.22	12.60423	2	30 30 11 N	090 46 08 W
7026	AK8413	TBM 7026			45.48	12.20284	2	30 30 15 N	090 45 20 W
0653	BJ0898	S 294	B		46.33	12.94748	2	30 30 17 N	090 44 48 W
0654	BJ0899	C 290	D		46.65	13.59721	2	30 30 12 N	090 44 37 W
0655	BJ0900	D 290	D		47.72	12.58057	2	30 30 10 N	090 43 54 W
0656	BJ0901	E 290	B		49.17	11.05422	2	30 30 10 N	090 43 00 W
0657	BJ0902	F 290	B		50.29	10.88858	2	30 30 11 N	090 42 18 W
0658	BJ0903	H 290	D		51.50	11.47867	2	30 30 12 N	090 41 30 W
0659	BJ0904	G 290	B		52.94	12.99871	2	30 30 13 N	090 40 37 W
0660	BJ0905	GAGING STATION USGS	B		52.97	13.00378	2	30 30 12 N	090 40 36 W
0661	BJ0906	T 294	B		53.80	11.52144	2	30 30 14 N	090 40 08 W
0662	BJ0907	J 290	D		54.09	12.13347	2	30 30 12 N	090 39 55 W
0663	BJ0908	K 290	D		55.35	12.48907	2	30 30 12 N	090 39 08 W
0664	BJ0909	ALLEN RM 2	C		56.39	12.68108	2	30 30 14 N	090 38 27 W
0665	BJ0910	ALLEN RM 3	C		56.41	12.71834	2	30 30 14 N	090 38 27 W
0666	BJ0911	ALLEN RESET	C		56.43	12.80432	2	30 30 14 N	090 38 26 W
0667	BJ0912	P 290	D		57.56	13.27475	2	30 30 12 N	090 37 46 W
0668	BJ0913	N 290	D		58.95	13.66822	3	30 30 15 N	090 36 52 W
0669	BJ0914	M 290	B		59.77	13.90382	2	30 30 16 N	090 36 22 W

0670	BJ0915	L 290	D		61.03	12.54978	2	30 30 16 N	090 35 36 W
0671	BJ0916	TT 13 L	C		62.00	12.37411	2	30 30 16 N	090 34 56 W
0672	BJ0917	V 294	B		62.56	10.37115	2	30 30 14 N	090 34 37 W
0673	BJ0918	U 294	B		62.77	11.26045	2	30 30 15 N	090 34 26 W
0674	BJ0919	W 294	C		64.37	10.89455	2	30 30 14 N	090 33 30 W
0675	BJ0920	U 21	C	1	64.44	11.69767	2	30 30 15 N	090 33 31 W
0674	BJ0919	W 294	C	*	64.37	10.89455		30 30 14 N	090 33 30 W
0676	BJ0921	X 294	B		65.62	10.23294	2	30 30 16 N	090 32 43 W
0677	BJ0922	Y 294	D		66.64	12.15735	4	30 30 12 N	090 32 02 W
0678	BJ0923	TT 14 L USGS	C		66.86	12.32401	2	30 30 18 N	090 32 01 W
0679	BJ0924	G 295	C		68.09	11.98600	2	30 30 18 N	090 31 18 W
0680	BJ0925	F 295	B		69.38	12.05410	2	30 30 15 N	090 30 27 W
0681	BJ0926	E 295	B		69.80	13.27811	2	30 30 16 N	090 30 15 W
0682	BJ0927	C 295	D		70.75	11.67033	2	30 30 14 N	090 29 38 W
0683	BJ0928	B 295	B		71.86	11.58915	2	30 30 14 N	090 28 58 W
0684	BJ0929	Z 178	D	1	72.24	12.32537	2	30 30 23 N	090 29 00 W
0683	BJ0928	B 295	B	*	71.86	11.58915		30 30 14 N	090 28 58 W
0685	BJ0930	Y 178	D		72.23	11.67459	2	30 30 16 N	090 28 49 W
0686	BJ0931	D 295	D		73.34	11.41011	2	30 30 20 N	090 28 00 W
0687	BJ0932	Z 294	B		73.91	13.24337	2	30 30 26 N	090 27 46 W
0688	BJ0933	P 19	B		73.99	14.62078	2	30 30 24 N	090 27 44 W
0689	BJ0934	P 275	D	1	74.13	12.87794	2	30 30 28 N	090 27 42 W
0688	BJ0933	P 19	B	*	73.99	14.62078		30 30 24 N	090 27 44 W
0690	BJ0935	TT 16 L RESET	C		74.28	14.20370	2	30 30 14 N	090 27 42 W
0691	BJ0936	1101	C		74.32	12.51970	2	30 30 14 N	090 27 44 W
0692	BJ0937	HAMMOND RESET	C		74.66	13.03936	2	30 30 17 N	090 27 28 W
2999	BJ0940	A 295	B	1	75.11	12.35691	2	30 30 30 N	090 27 28 W
3000	BJ0941	S 21	C	1	76.10	12.13608	2	30 30 36 N	090 26 58 W
0692	BJ0937	HAMMOND RESET	C	*	74.66	13.03936		30 30 17 N	090 27 28 W
0693	BJ0939	TA 268	A		75.56	10.77714	2	30 30 01 N	090 27 40 W
0694	BJ0938	TA 253	A		75.71	10.39681	2	30 29 58 N	090 27 40 W

UNADJUSTED DATA RELEVELING LINE NO.:
L24133/17

ORDER/CLASS = 1/1

PROJECT TITLE: NEW ORLEANS DISTRICT CORPS OF ENGINEERS LEVELING
BATON ROUGE TO 2 MI N OF UNION
AGENCY:NGS STATES: LA LEVELING BEGAN 08/11/1976 AND ENDED 04/28/1977 TOL = 3.0 MM X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 16.318 METERS FOR: Q 287
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY		SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE
1002	BJ0555	Q 287	B		0.00	16.31800		30 28 05 N	091 11 19 W
2990	BJ0958	J 22	C		0.22	15.54953	5	30 27 58 N	091 11 21 W
1063	BJ0959	P 296	B		0.84	17.00661	2	30 27 42 N	091 11 13 W
7607	AK8906	TBM 7607			1.21	14.28208	3	30 27 32 N	091 11 12 W
1064	BJ0960	L 22	D		1.47	19.92023	2	30 27 25 N	091 11 12 W
1008	BJ0961	17 B 013	C		1.73	16.10786	2	30 27 22 N	091 11 23 W
1065	BJ0962	C 204	C		2.14	13.27296	2	30 27 09 N	091 11 27 W
7606	AK8907	TBM 7606			2.71	11.74646	2	30 26 52 N	091 11 25 W
1066	BJ0963	B 197 WELL	D	1	2.75	10.50777	2	30 26 51 N	091 11 23 W
7606	AK8907	TBM 7606		*	2.71	11.74646		30 26 52 N	091 11 25 W
1067	BJ0964	2	D		2.84	11.43851	2	30 26 48 N	091 11 24 W
7605	AK8908	TBM 7605		1	2.96	17.37708	2	30 26 48 N	091 11 20 W
1068	BJ0965	XXXI	B	2	3.01	18.54422	2	30 26 48 N	091 11 21 W
7605	AK8908	TBM 7605		*	2.96	17.37708		30 26 48 N	091 11 20 W
1069	BJ0966	NORTH BOULEVARD CAP	D	1	3.17	16.70007	2	30 26 49 N	091 11 13 W
1070	BJ0967	POST OFFICE	B	1	3.20	17.62480	2	30 26 49 N	091 11 13 W
1067	BJ0964	2	D	*	2.84	11.43851		30 26 48 N	091 11 24 W
1071	BJ0968	K 22	D	1	2.95	12.00813	3	30 26 45 N	091 11 25 W
1067	BJ0964	2	D	*	2.84	11.43851		30 26 48 N	091 11 24 W
7604	AK8909	TBM 7604			3.17	9.54203	3	30 26 38 N	091 11 24 W
0631	BJ0969	M 197	C	1	3.95	11.22538	2	30 26 35 N	091 10 55 W
0632	BJ0970	N 197	B	1	4.35	15.05684	2	30 26 36 N	091 10 42 W
0633	BJ0971	P 197	C	1	4.87	17.06767	2	30 26 37 N	091 10 23 W
0634	BJ0972	Q 197	C	1	6.23	13.41981	2	30 26 41 N	091 09 34 W
0635	BJ0973	M 288	C	1	6.88	13.79522	2	30 26 38 N	091 09 11 W
7601	AK8910	TBM 7601		1	7.47	15.70659	2	30 26 40 N	091 08 50 W
0636	BJ0974	R 197 WELL	D	1	7.96	15.53009	2	30 26 41 N	091 08 33 W
7600	AK8911	TBM 7600		1	8.44	16.28803	2	30 26 41 N	091 08 16 W
0637	BJ0975	W 197	D	2	8.79	16.84317	2	30 26 50 N	091 08 16 W
7600	AK8911	TBM 7600		*	8.44	16.28803		30 26 41 N	091 08 16 W
0638	BJ0976	L 288	C	1	9.24	17.06386	2	30 26 40 N	091 07 48 W
0639	BJ0977	N 288	C	1	10.18	16.53358	2	30 26 41 N	091 07 16 W
0640	BJ0978	U 197	D	1	11.17	15.97020	2	30 26 44 N	091 06 39 W
0641	BJ0979	V 197	C	1	11.27	15.65466	2	30 26 48 N	091 06 39 W

1005	BJ0980	DONAIR RM 2	C	1	11.54	15.16077	2	30 26 51 N	091 06 40 W
1006	BJ0981	DONAIR	C	1	11.55	15.08263	2	30 26 56 N	091 06 42 W
1007	BJ0982	DONAIR RM 1	C	1	11.56	15.19287	3	30 26 53 N	091 06 40 W
1012	BJ0983	102 EBRPAR	C	1	11.79	15.27921	2	30 27 00 N	091 06 50 W
1011	BJ0984	DONAIR AZ MK	C	1	12.73	15.21128	2	30 27 03 N	091 06 18 W
1009	BJ0985	A 3045 A	C	1	12.92	14.79382	2	30 27 03 N	091 06 08 W
1010	BJ0986	ROUGE	C	2	13.61	19.67503	2	30 27 10 N	091 05 46 W
1009	BJ0985	A 3045 A	C	*	12.92	14.79382		30 27 03 N	091 06 08 W
7608	AK8912	TBM 7608		1	13.89	14.95015	2	30 27 26 N	091 06 24 W
1013	BJ0987	17	C	1	14.89	15.60428	3	30 27 50 N	091 06 44 W
0574	BJ0862	T 216	C	1	15.55	17.04641	2	30 28 16 N	091 06 57 W
7604	AK8909	TBM 7604		*	3.17	9.54203		30 26 38 N	091 11 24 W
1072	BJ0988	J 288	B		3.76	10.72699	2	30 26 20 N	091 11 24 W
7610	AK8913	TBM 7610			4.27	8.70346	2	30 26 04 N	091 11 25 W
1073	BJ0989	C 198	B	1	5.20	14.59654	2	30 25 55 N	091 11 07 W
7610	AK8913	TBM 7610		*	4.27	8.70346		30 26 04 N	091 11 25 W
1074	BJ0990	K 288	C		4.53	9.88917	2	30 25 56 N	091 11 25 W
1075	BJ0991	D 197	C		5.42	10.93628	3	30 25 30 N	091 11 30 W
1076	BJ0992	C 927 LAGS	C		6.70	7.57856	2	30 24 50 N	091 11 41 W
1077	BJ0993	C 929	C		8.08	7.59583	3	30 24 10 N	091 12 02 W
1078	BJ0994	C 930	C		8.63	7.45662	3	30 23 53 N	091 12 13 W
1079	BJ0995	ARLINGTON CAP RESET	D		8.67	7.51859	3	30 23 53 N	091 12 11 W
1080	BJ0996	B 198	B		10.05	7.46716	5	30 23 17 N	091 12 42 W
1081	BJ0997	W 94 RESET	C		11.71	8.42031	3	30 22 37 N	091 13 24 W
1082	BJ0998	C 936	C		13.04	9.22653	2	30 22 02 N	091 13 52 W
1083	BJ0999	XXV11	C		14.37	9.16909	2	30 21 21 N	091 13 59 W
1084	BJ1000	C 940	C		15.11	11.53978	2	30 21 01 N	091 13 47 W
1085	BJ1001	E 197	C		16.07	8.75665	2	30 21 03 N	091 13 14 W
7404	AK8914	TBM 7404			16.92	8.71514	2	30 21 05 N	091 12 43 W
1086	BJ1002	C 944	C		17.63	12.67568	2	30 21 06 N	091 12 18 W
1088	BJ1003	L 197 RESET	C		19.35	6.65683	2	30 21 13 N	091 11 19 W
1089	BJ1004	K 197 RESET	D		20.80	7.35094	2	30 21 08 N	091 10 22 W
1090	BJ1005	P 288	C		22.23	8.15628	2	30 20 54 N	091 09 31 W
1091	BJ1006	A 198	B		23.65	8.07930	2	30 20 34 N	091 08 43 W
1092	BJ1007	BURTVILLE RM 3	C		25.39	6.70795	2	30 19 54 N	091 08 03 W
1093	BJ1008	BURTVILLE RESET	C		25.43	6.84162	2	30 19 54 N	091 08 03 W
1094	BJ1009	J 197	C		27.25	8.09259	2	30 18 59 N	091 08 17 W
1095	BJ1010	RIVER MISSISSIPPI MP 15	D		27.87	7.33315	3	30 18 46 N	091 08 35 W
1096	BJ1011	H 197	C		28.78	7.25604	2	30 18 34 N	091 09 04 W
1097	BJ1012	RIVER MISSISSIPPI MP 16	D		29.75	7.57935	2	30 18 31 N	091 09 40 W
1098	BJ1013	G 197	C		29.95	7.49263	2	30 18 32 N	091 09 47 W

1099	BJ1014	IB 44	A		31.22	7.09189	2	30 18 33 N	091 10 34 W
1100	BJ1015	PERTUIT	C		32.37	8.21128	2	30 18 40 N	091 11 14 W
1101	BJ1016	Q 288	C		34.03	7.47074	2	30 18 25 N	091 12 12 W
7405	AK8915	TBM 7405			35.66	8.37798	2	30 18 08 N	091 13 09 W
1102	BJ1017	IB 40 USGS	D	1	35.82	8.12462	2	30 18 07 N	091 13 09 W
7405	AK8915	TBM 7405		*	35.66	8.37798		30 18 08 N	091 13 09 W
1103	BJ1018	RIVER MISSISSIPPI MP 20	D		35.97	8.56439	2	30 18 05 N	091 13 20 W
1003	BJ1019	F 197	C		36.27	8.56737	2	30 17 56 N	091 13 23 W
7602	AK8916	TBM 7602		1	37.14	4.92467	2	30 17 37 N	091 13 37 W
7603	AK8917	TBM 7603		1	37.72	6.22679	2	30 17 24 N	091 13 46 W
0547	BJ0579	X 290	B	1	38.00	8.05686	2	30 17 17 N	091 13 51 W
1003	BJ1019	F 197	C	*	36.27	8.56737		30 17 56 N	091 13 23 W
1105	BJ1020	Q 94 RESET	C		37.67	8.33707	2	30 17 23 N	091 12 49 W
1106	BJ1021	178 2 RESET	C		39.10	8.31178	2	30 17 07 N	091 12 01 W
1107	BJ1022	P 94 RESET	C		39.91	8.56242	2	30 17 16 N	091 11 33 W
1108	BJ1023	IB 41 USGS	D		41.56	7.29013	2	30 17 23 N	091 10 33 W
1109	BJ1024	N 94 RESET	C		41.79	7.71441	2	30 17 22 N	091 10 27 W
1110	BJ1025	ANGER RESET	D		42.41	7.73024	2	30 17 23 N	091 10 04 W
1111	BJ1026	R 288	C		43.66	7.13993	2	30 17 13 N	091 09 19 W
1112	BJ1027	IB 47	D		45.00	7.23649	2	30 17 02 N	091 08 33 W
7406	AK8918	TBM 7406			46.11	7.19640	2	30 16 45 N	091 07 57 W
1113	BJ1028	GAGE 32 BOLT	D	1	46.17	6.23394	2	30 16 46 N	091 07 58 W
7406	AK8918	TBM 7406		*	46.11	7.19640		30 16 45 N	091 07 57 W
1475	BJ1029	L 94	C		47.98	6.96923	2	30 16 16 N	091 06 57 W
1476	BJ1030	K 94	C		49.77	6.72578	2	30 15 33 N	091 06 14 W
1404	BJ1031	K 297	B		50.00	7.60782	2	30 15 26 N	091 06 14 W
1478	BJ1032	24 A 001	C	1	50.48	6.22619	2	30 15 27 N	091 05 55 W
1404	BJ1031	K 297	B	*	50.00	7.60782		30 15 26 N	091 06 14 W
1403	BJ1033	RIVER MISSISSIPPI MP 30	C		51.12	5.67879	2	30 14 50 N	091 06 13 W
1405	BJ1034	3004	C		52.34	6.21220	2	30 14 19 N	091 06 41 W
1406	BJ1035	180 B CAP	D		52.60	7.10023	2	30 14 01 N	091 06 44 W
1407	BJ1036	J 94 RESET	C		53.78	7.33312	2	30 13 56 N	091 07 24 W
7407	AK8919	TBM 7407			54.80	6.54917	2	30 13 35 N	091 07 49 W
1408	BJ1037	GAGE 31 CAP	D	1	55.11	6.51804	2	30 13 25 N	091 07 43 W
7407	AK8919	TBM 7407		*	54.80	6.54917		30 13 35 N	091 07 49 W
1409	BJ1038	X 192	C		55.15	7.04608	2	30 13 28 N	091 07 58 W
1410	BJ1039	RIVER MISSISSIPPI MP 33	D		55.97	7.41719	2	30 13 08 N	091 08 19 W
1411	BJ1040	H 94	C		56.64	7.78284	2	30 12 49 N	091 08 36 W
1412	BJ1041	RIVER MISSISSIPPI MP 34	D		57.48	7.16495	2	30 12 26 N	091 08 51 W
1413	BJ1042	W 192	C		57.55	7.39369	2	30 12 23 N	091 08 52 W
1414	BJ1043	RIVER MISSISSIPPI MP 35	D		58.80	7.58005	2	30 11 45 N	091 09 10 W

1415	BJ1044	CURLEY CAP	A	1	59.22	7.37033	2	30 11 46 N	091 08 55 W
1414	BJ1043	RIVER MISSISSIPPI MP 35	D	*	58.80	7.58005		30 11 45 N	091 09 10 W
1416	BJ1045	V 192	C		58.90	7.65574	2	30 11 40 N	091 09 11 W
1417	BJ1046	RIVER MISSISSIPPI MP 36	D		60.27	7.71407	2	30 11 04 N	091 08 52 W
1419	BJ1047	N 297	B		60.60	8.37018	2	30 11 03 N	091 08 40 W
1420	BJ1048	F 94	C		61.94	7.45534	2	30 11 26 N	091 08 00 W
7408	AK8076	TBM 7408			62.84	7.86243	2	30 11 43 N	091 07 35 W
1421	BJ1049	IB 58	D	1	63.16	7.11200	2	30 11 54 N	091 07 31 W
7408	AK8076	TBM 7408		*	62.84	7.86243		30 11 43 N	091 07 35 W
1422	BJ1050	RIVER MISSISSIPPI MP 38	D		63.22	7.55648	2	30 11 50 N	091 07 24 W
1423	BJ1051	U 192	C		63.40	7.43008	2	30 11 57 N	091 07 14 W
1424	BJ1052	E 94	C		64.74	6.91402	2	30 12 22 N	091 06 37 W
1425	BJ1053	RIVER MISSISSIPPI MP 40	D		66.24	6.63978	2	30 12 48 N	091 05 50 W
1426	BJ1054	M 297	B		66.41	7.02720	2	30 12 50 N	091 05 43 W
1427	BJ1055	CARVILLE CAP	D	1	66.79	6.29443	4	30 13 02 N	091 05 48 W
1426	BJ1054	M 297	B	*	66.41	7.02720		30 12 50 N	091 05 43 W
7409	AK8077	TBM 7409			67.27	6.60027	2	30 12 59 N	091 05 13 W
1428	BJ1056	3009	C		67.96	5.75162	2	30 13 06 N	091 04 49 W
1429	BJ1057	3010	C		68.82	5.89032	2	30 13 10 N	091 04 20 W
1430	BJ1058	RIVER MISSISSIPPI MP 42	D		69.37	5.65031	2	30 13 08 N	091 03 58 W
1431	BJ1059	3011	C		69.55	5.56749	2	30 13 06 N	091 03 49 W
2998	BJ1060	RUSSELL CAP	D		70.98	6.26492	2	30 13 00 N	091 03 00 W
7410	AK8078	TBM 7410			71.92	6.40636	2	30 12 52 N	091 02 30 W
1432	BJ1061	R 192	D		72.65	5.20467	2	30 12 46 N	091 02 07 W
1433	BJ1062	3017 RESET	C		74.27	7.39305	2	30 12 10 N	091 01 29 W
1436	BJ1063	GEISMAR RM 6	C	1	74.49	6.88157	2	30 12 11 N	091 01 21 W
1434	BJ1064	GEISMAR	C	1	74.53	6.79557	2	30 12 12 N	091 01 22 W
1435	BJ1065	GEISMAR RM 5	C	1	74.56	7.00953	2	30 12 12 N	091 01 24 W
1437	BJ1066	NEW RIVER CAP	D	1	74.60	7.35535	2	30 12 14 N	091 01 22 W
1438	BJ1067	3 V 13 LADH	C	1	75.88	5.66373	2	30 12 43 N	091 00 49 W
1433	BJ1062	3017 RESET	C	*	74.27	7.39305		30 12 10 N	091 01 29 W
1439	BJ1068	D 94 RESET	C		75.87	6.89690	2	30 11 29 N	091 00 53 W
7411	AK8079	TBM 7411			77.57	7.00798	2	30 10 46 N	091 00 21 W
1441	BJ1069	C 94 RESET	C	1	77.80	7.21510	2	30 10 39 N	091 00 12 W
7411	AK8079	TBM 7411		*	77.57	7.00798		30 10 46 N	091 00 21 W
1442	BJ1070	P 297	A		78.80	7.43313	2	30 10 15 N	090 59 57 W
1444	BJ1071	P 192	C		79.43	7.87868	2	30 09 58 N	090 59 45 W
1445	BJ1072	A 94 RESET	C		80.77	5.83167	2	30 09 13 N	090 59 34 W
7412	AK8080	TBM 7412			81.98	4.66825	2	30 08 42 N	090 59 52 W
7413	AK8081	TBM 7413			83.09	5.46797	2	30 08 13 N	091 00 09 W
1449	BJ1073	L 297	C		84.51	5.50069	2	30 07 36 N	091 00 30 W

1450	BJ1074	187/2 CAP	D		85.62	7.21041	2	30 07 12 N	091 00 48 W
1451	BJ1075	Z 197	B		87.15	6.21385	2	30 07 10 N	090 59 54 W
1452	BJ1076	TT 3 P RESET	C		87.94	6.13758	2	30 07 09 N	090 59 24 W
1453	BJ1077	BRINGIER CAP	D		88.74	6.12389	2	30 07 04 N	090 58 56 W
1454	BJ1078	RIVER MISSISSIPPI MP 56	C		89.94	5.79490	2	30 06 55 N	090 58 15 W
1455	BJ1079	YY 93	C		90.49	6.46715	2	30 06 52 N	090 57 57 W
1456	BJ1080	188/1 CAP	D		92.08	6.35201	2	30 07 12 N	090 57 37 W
1457	BJ1081	XX 93	C		93.55	6.26475	2	30 07 43 N	090 57 10 W
7414	AK8082	TBM 7414			94.78	4.10712	2	30 08 08 N	090 56 48 W
1459	BJ1082	N 192	C		96.44	4.90345	2	30 08 42 N	090 56 19 W
1460	BJ1083	189/1 CAP	D		96.62	4.96464	2	30 08 52 N	090 56 19 W
1461	BJ1084	M 192	C		97.41	5.20954	2	30 08 55 N	090 55 55 W
1462	BJ1085	L 192	C		98.36	5.99249	2	30 08 57 N	090 55 19 W
1463	BJ1086	MILES RM 4	C	1	99.66	3.12328	2	30 09 39 N	090 55 13 W
1465	BJ1087	MILES RM 3	C	1	99.69	3.11381	2	30 09 39 N	090 55 13 W
1462	BJ1085	L 192	C	*	98.36	5.99249		30 08 57 N	090 55 19 W
1466	BJ1088	Q 297	C		99.55	5.78498	2	30 08 19 N	090 55 27 W
1467	BJ1089	K 192 RESET 1965	C		101.04	5.54329	2	30 07 56 N	090 54 31 W
1468	BJ1090	J 192	C		102.58	4.06461	2	30 07 11 N	090 54 12 W
1469	BJ1091	1091 LAGS	C		104.16	4.21341	2	30 06 20 N	090 53 59 W
1471	BJ1092	H 192	B		105.48	6.92198	2	30 05 55 N	090 54 26 W
1473	BJ1093	L 229	B	1	106.41	11.09769	2	30 06 01 N	090 53 57 W
1471	BJ1092	H 192	B	*	105.48	6.92198		30 05 55 N	090 54 26 W
1481	BJ1094	R 297	C		107.28	6.96840	2	30 06 54 N	090 54 42 W
1482	BJ1096	T 297	B	1	108.11	6.95276	2	30 06 50 N	090 55 09 W
1481	BJ1094	R 297	C	*	107.28	6.96840		30 06 54 N	090 54 42 W
1480	BJ1095	S 297	B		107.45	7.23184	2	30 06 55 N	090 54 41 W

UNADJUSTED DATA — LINE NO.: L24813

ORDER/CLASS = 2/1

PROJECT TITLE: BATON ROUGE TO HAMMOND VIA INTERSTATE HIGHWAY 12
AGENCY:LADTD STATES: LA LEVELING BEGAN 11/02/1983 AND ENDED 07/06/1984 TOL = 6.0 MM X SQRT(KM)

THE FOLLOWING CORRECTIONS WERE APPLIED TO THE OBSERVATIONS:
ROD; LEVEL; TEMPERATURE; ASTRO; REFRACTION; MAGNETIC

THE DERIVED UNADJUSTED HEIGHTS ARE BASED ON A STARTING HEIGHT OF: 13.167 METERS FOR: Q 286
AND MUST NOT BE USED AS OFFICIAL HEIGHTS!!!

SPSN	ACRN	DESIGNATION AND STABILITY	SPUR LEVEL	DIST (Km)	UNADJUSTED HEIGHT (m)	NO. OF RUNS	APPROXIMATE LATITUDE	APPROXIMATE LONGITUDE

1301	BJ0875	Q 286	B		0.00	13.16680		30 27 53 N	090 59 28 W
1302	BJ0874	STEVENS RM 3	C		0.20	11.40625	2	30 27 58 N	090 59 35 W
1303	BJ0873	STEVENS RESET	C		0.21	11.92255	2	30 27 57 N	090 59 28 W
1304	BJ3760	STEVENS RM 2	D		0.25	11.98786	2	30 27 58 N	090 59 35 W
1305	BJ3761	STEVENS AZ MK 2	C		0.58	12.66668	2	30 27 59 N	090 59 47 W
1306	BJ3762	229 AZ MK 2	C		1.89	12.11826	4	30 27 36 N	091 00 28 W
1307	BJ3763	229 73	C		1.95	13.04884	2	30 27 34 N	091 00 30 W
1308	BJ3764	17 D 003	C		3.94	18.26521	2	30 26 32 N	091 00 27 W
1309	BJ3765	17 D 002	C	1	5.63	20.01019	2	30 26 15 N	091 01 27 W
1310	BJ3766	17 D 001	C	1	7.29	12.88886	2	30 26 01 N	091 02 25 W
1311	BJ3767	HARE RM 2	C	1	9.11	13.52582	2	30 25 59 N	091 03 27 W
1312	BJ3768	HARE	C	1	9.12	13.57152	2	30 25 58 N	091 03 26 W
1313	BJ3769	HARE RM 1	C	1	9.13	13.41744	2	30 25 59 N	091 03 27 W
1314	BJ3770	17 C 002	C	1	9.39	13.87829	2	30 25 49 N	091 03 25 W
1315	BJ3771	17 C 001	C	1	10.31	19.67140	2	30 25 38 N	091 03 58 W
1316	BJ3772	LANE RM 1	C	1	11.15	19.49865	2	30 25 27 N	091 04 28 W
1317	BJ3773	LANE	C	1	11.16	19.73639	2	30 25 26 N	091 04 27 W
1318	BJ3774	LANE RM 2	C	1	11.17	19.76456	2	30 25 26 N	091 04 27 W
1308	BJ3764	17 D 003	C	*	3.94	18.26521		30 26 32 N	091 00 27 W
1319	BJ3775	17 D 004	C		5.99	14.25201	2	30 26 49 N	090 59 14 W
1320	BJ3776	17 D 005	C		7.87	17.63442	2	30 27 05 N	090 58 09 W
1321	BJ0877	M 286	D	1	9.99	11.74210	2	30 28 06 N	090 58 02 W
1320	BJ3776	17 D 005	C	*	7.87	17.63442		30 27 05 N	090 58 09 W
1322	BJ3777	DENHAM AZ MK	B		9.18	18.30437	2	30 27 16 N	090 57 21 W
1323	BJ3778	DENHAM RM 3	C		9.70	10.85509	2	30 27 25 N	090 57 03 W
1324	BJ3779	DENHAM	C		9.73	10.99304	2	30 27 23 N	090 57 02 W
1325	BJ3780	DENHAM RM 4	C		9.77	11.31537	2	30 27 25 N	090 57 05 W
1326	BJ3781	32 A 001	C		10.20	18.50887	2	30 27 24 N	090 56 47 W
1327	BJ3782	32 A 002	C		11.51	12.01081	2	30 27 37 N	090 56 01 W
1328	BJ3783	COYEL RM 2	C		13.33	18.44088	2	30 27 55 N	090 54 57 W
1329	BJ3784	COYEL	C		13.34	18.63808	2	30 27 53 N	090 54 56 W
1330	BJ3785	COYEL RM 1	C		13.35	18.92110	2	30 27 55 N	090 54 57 W
1331	BJ3786	COYEL AZ MK	C	1	14.27	11.63482	2	30 27 22 N	090 54 55 W
1330	BJ3785	COYEL RM 1	C	*	13.35	18.92110		30 27 55 N	090 54 57 W
1332	BJ3787	32 B 001	C		15.39	11.84280	2	30 27 58 N	090 53 40 W
1333	BJ3788	32 B 002	C		16.29	10.74865	2	30 27 59 N	090 53 06 W
1334	BJ3789	32 B 003	C		18.62	18.12458	2	30 28 12 N	090 51 46 W
1335	BJ0888	T 286	D	1	20.89	13.53876	2	30 29 19 N	090 51 31 W
1334	BJ3789	32 B 003	C	*	18.62	18.12458		30 28 12 N	090 51 46 W
1336	BJ3790	32 B 004	C		20.34	11.52149	3	30 28 19 N	090 50 44 W

1337	BJ3791	DUMP AZ MK	B		21.24	12.02927	2	30 28 23 N	090 50 10 W
1338	BJ3792	DUMP	C		21.89	10.80331	3	30 28 25 N	090 49 48 W
1339	BJ3793	32 C 001	C		22.90	11.69934	2	30 28 22 N	090 49 11 W
1340	BJ3794	SUMA	C		25.13	17.71168	2	30 28 22 N	090 47 51 W
1341	BJ3795	SUMA AZ MK	C	1	26.31	10.34183	2	30 28 56 N	090 47 38 W
1340	BJ3794	SUMA	C	*	25.13	17.71168		30 28 22 N	090 47 51 W
1342	BJ3796	32 D 001	C		26.75	11.57470	2	30 28 25 N	090 46 51 W
1343	BJ3797	32 V 5	C		28.44	9.50094	2	30 28 27 N	090 45 50 W
1344	BJ3798	32 D 002	C		29.98	17.85811	4	30 28 25 N	090 44 51 W
1345	BJ3799	32 V 1	C	1	31.65	11.88717	2	30 29 20 N	090 44 58 W
1346	BJ0898	S 294	B	1	33.41	12.91826	2	30 30 17 N	090 44 48 W
1344	BJ3798	32 D 002	C	*	29.98	17.85811		30 28 25 N	090 44 51 W
1347	BJ3800	RED OAK AZ MK	C		32.57	10.04335	2	30 28 24 N	090 43 17 W
1348	BJ3801	32 D 003	C		32.75	16.97777	2	30 28 27 N	090 43 23 W
1349	BJ3802	RED OAK RM 2	C		33.06	10.87199	3	30 28 36 N	090 43 33 W
1350	BJ3803	RED OAK	C		33.10	10.56850	3	30 28 34 N	090 43 31 W
1351	BJ3804	RED OAK RM 1	C		33.14	11.03533	2	30 28 35 N	090 43 31 W
1352	BJ3805	32 E 001	C		34.41	9.25120	2	30 28 33 N	090 42 45 W
1353	BJ3806	32 E 002	C		35.49	11.70092	2	30 28 32 N	090 42 04 W
1354	BJ3807	32 E 003	C		37.13	9.98680	2	30 28 29 N	090 41 03 W
1355	BJ3808	32 E 004	C		38.73	10.83004	2	30 28 26 N	090 40 03 W
1356	BJ3809	CAT AZ MK	C		40.78	9.65578	2	30 28 29 N	090 38 47 W
1357	BJ3810	32 V 2	C	1	42.39	9.55375	2	30 29 03 N	090 39 06 W
1358	BJ3811	32 V 3	C	1	44.07	11.06993	2	30 29 42 N	090 39 49 W
1359	BJ0906	T 294	B	1	45.14	11.49071	2	30 30 14 N	090 40 08 W
1356	BJ3809	CAT AZ MK	C	*	40.78	9.65578		30 28 29 N	090 38 47 W
1360	BJ3812	32 E 005	C		41.21	16.98299	2	30 28 27 N	090 38 33 W
1361	BJ3813	CAT	C		41.55	9.88610	2	30 28 16 N	090 38 32 W
1362	BJ3814	32 F 001	C		43.68	11.06001	2	30 28 28 N	090 37 18 W
1363	BJ3815	32 F 002	C		45.55	10.31944	2	30 28 31 N	090 36 08 W
1364	BJ3816	32 F 003	C		47.88	17.38222	2	30 28 40 N	090 34 43 W
1365	BJ3817	32 V 4	C	1	49.38	11.15095	2	30 29 25 N	090 34 57 W
1366	BJ0916	TT 13 L	C	1	50.87	12.33872	2	30 30 16 N	090 34 56 W
1364	BJ3816	32 F 003	C	*	47.88	17.38222		30 28 40 N	090 34 43 W
1367	BJ3818	32 V 6	B		49.87	8.87002	2	30 28 43 N	090 33 30 W
1368	BJ3819	32 F 004	C		51.47	16.80166	2	30 28 45 N	090 32 32 W
1369	BJ3820	32 F 005	C		53.49	10.68026	2	30 28 46 N	090 31 17 W
1370	BJ3821	32 F 006	C		55.61	17.09590	2	30 28 45 N	090 30 02 W
1371	BJ3822	32 F 007	C		56.98	16.16642	3	30 28 43 N	090 29 18 W
1372	BJ3823	32 F 008	C		58.71	17.68142	2	30 29 27 N	090 29 53 W
1373	BJ3824	32 F 009	C		59.80	12.57236	2	30 29 56 N	090 30 12 W

1374	BJ0925	F 295	B		60.65	12.01816	2	30 30 15 N	090 30 27 W
1375	BJ0926	E 295	B	1	61.07	13.22649	2	30 30 16 N	090 30 15 W
1374	BJ0925	F 295	B	*	60.65	12.01816		30 30 15 N	090 30 27 W
1376	BJ0924	G 295	C		61.94	11.95440	2	30 30 18 N	090 31 18 W

APPENDIX F DETAILS ON HYDROGEOLOGY RESEARCH

Initially I contacted B. Pierre Sargent, Hydrogeologist with the USGS, who referred me to the Water Resources Report No. 15 that contains groundwater usage for the year 2000, and is broken down both by parish and aquifer systems. According to this report, there are three main aquifer systems that provide groundwater to the East Baton Rouge Parish Area and they are listed in order of increasing usage: the Chicot Equivalent Aquifer System, the Evangeline Equivalent Aquifer System, and the Jasper Equivalent Aquifer System. The actual groundwater withdrawals in millions of gallons per day (MGD) for each of these aquifer systems in the year 2000 are as follows: the Chicot Equivalent Aquifer System is 15.57 MGD, the Evangeline Equivalent Aquifer System is 42.51 MGD, and the Jasper Equivalent Aquifer System is 77.48 MGD. Each of these systems includes several of the well known sand interval aquifers in the East Baton Rouge Parish Area. The Chicot Equivalent Aquifer System includes the Shallow Sands, 400 ft Sand and 600 ft Sand Aquifers. The Evangeline Equivalent Aquifer System includes the 800 ft Sand, the 1000 ft Sand, the 1200 ft Sand, the 1500 ft Sand and the 1700 ft Sand Aquifers. It must be noted that historically the shallower aquifer systems were the main aquifer systems, back in the 1950's and 1960's. An example of this is evident in Kazmann 1970 when he states that the "most important source of water in Baton Rouge" is a combination of the 400 ft and 600 ft Sands which are part of the Chicot Equivalent Aquifer System. However, currently the largest aquifer system is the Jasper Equivalent Aquifer System, which includes the 2000 ft Sand, the 2400 ft Sand and the 2800 ft Sand Aquifers. This report helped give a general perspective of usage of the aquifer systems; however, since each of the USGS wells directly adjacent to the field study areas were screened in a different sand interval aquifer, it was difficult to determine which of these aquifers were the major or minor suppliers of groundwater to the area.

The Southern Hills Regional Aquifer System is the third most heavily pumped aquifer system within the state of Louisiana, with the Chicot Aquifer System being first, the Mississippi River Alluvial Aquifer as second and the Sparta Aquifer in last place (Tomazewskie et. al., 2002). Before the Southern Hills Regional Aquifer System developed into a primary source of potable water, the potentiometric surface was highest where it outcropped in Southeastern Louisiana and Southwestern Mississippi. According to Meyer and Turcan (1955), withdrawals from the industrial area in Baton Rouge began in 1914. As industry developed and the city grew, by the 1970's water levels began declining in response to these demands on the groundwater aquifer system (Dial, 1968). As demands on the aquifer system continued, the effect on the individual sand aquifers started to be observed. For instance, by the year 2000, water levels in the "2000-foot Sand" had declined to approximately 200 ft below sea level in East Baton Rouge Parish. Presently, approximately 70 percent of the ground-water withdrawn in the Baton Rouge area is from deep aquifers (1200 ft Sand, 1500 ft Sand, 2000 ft Sand, 2400 ft Sand, and 2800 ft Sand). Overall, the water levels in these large withdrawal deep aquifers have declined from 0.2 ft/yr to 3.5 ft/yr or more during the period from 1990 to 2000 (Tomaszewski, et al., 2002). Compaction not only affects the water levels in individual wells, but also affects subsidence rates along the fault systems due to changes in effective stress.

Next I contacted Dan Tomaszewski, Groundwater Specialist for the USGS in Baton Rouge, and he was able to provide me with 2003 data based on the actual sand interval aquifers. The five main sand interval aquifers are listed in order of increasing usage: the 1500 ft Sand, the 2400 ft Sand, the 1200 ft Sand, the 2800 ft Sand, and the 2000 ft Sand. According to Mr.

Tomaszewski, the approximate (values have not been finalized yet) pumpage values in 2003 for each of these main aquifers are as follows: the 1500 ft Sand is 16.1 MGD, the 2400 ft Sand is 18.5 MGD, the 1200 ft Sand is 21 MGD, the 2800 ft Sand is 29.5 MGD, and the 2000 ft Sand is 32.4 MGD. These aquifers combined total approximately 117.5 MGD which is 78% of the total amount of groundwater used in East Baton Rouge Parish for the year 2003. The six minor aquifers are listed in order of increasing usage and are as follows: the Shallow Sands, the 800 ft Sand, the 1700 ft Sand, the 1000 ft Sand, the 400 ft Sand, and the 600 ft Sand. The approximate pumpage values for these minor aquifers are as follows: the Shallow Sands are 0.048 MGD, the 800 ft Sand is 1.1 MGD, the 1700 ft Sand is 2.6 MGD, the 1000 ft Sand is 6.1 MGD, the 400 ft Sand is 10.8 MGD, and the 600 ft Sand is 12.3 MGD. These minor aquifers combined total approximately 32.948 MGD which equals the remaining 22% of the total groundwater usage for the 2003 data that Mr. Tomaszewski was able to provide. In comparing Mr. Tomaszewski's numbers to the Water Resources Special Report No. 15, there is an increase of almost 15 MGD from approximate values for 2003 vs. the verified values for 2000. The next course of action was to compare the major and minor aquifers outlined by Mr. Tomaszewski, to the adjacent USGS wells to the field study areas to determine where they are screened in relation to these aquifers.

Of the wells focused on in the field study areas, 21 are in the area of the former Woodlawn High School and 25 are in the area of the Glen Oaks High School. In the former Woodlawn High School area there are only two wells that are screened in one of the major aquifers and both are on the southern side, and 19 wells are screened in the minor aquifers with 6 on the northern side and 13 on the southern side of the Baton Rouge Fault. In the Glen Oaks High School area there are 14 wells that are screened in one of the major aquifers with 6 on the northern side and 8 on the southern side, and 11 wells are screened in the minor aquifers with 5 on the northern side and 6 on the southern side of the Scotlandville Fault. A comparison was then made between all of these wells with their years of available groundwater elevation data to the available years of NMO geodetic leveling data from the NGS and the 1999 LIDAR data.

I first compared the wells that are screened in the major aquifers to determine if they had groundwater elevation data for the same years that I had geodetic NMO and LIDAR data. For the two former Woodlawn High School wells, I found data for 1976, 1977, 1983, 1984, 1986, and in one case 1987, which matches up with 65% of the NGS NMO data. However, there are no data as recent as the 1999 LIDAR. For the 14 Glen Oaks High School wells, I found data for 1938 only for the major aquifer wells, which matches up with only 11% of the NGS NMO data, and no data as recent as the LIDAR. I then compared the wells that are screened in the minor aquifers.

I compared the wells screened in the minor aquifers to the same years that I have geodetic NMO and LIDAR data. For the 19 former Woodlawn High School wells, I found data for 1938, 1984 and 1987, which matches up with 33% of the NGS NMO data. Again there are no data as recent as the LIDAR. For the 11 Glen Oaks High School wells, I found data for 1976, 1977, 1983, 1984, 1986, and 1987 which matches up with 67% of the NGS NMO data. Additionally, data was available for 1999 to match up with the LIDAR data.

APPENDIX G GROUNDWATER ELEVATION DATA VALUES FOR USGS WELLS

WELLS IN AREA OF FORMER WOODLAWN HIGH SCHOOL

USGS 302345091022101 EB- 147

East Baton Rouge County, Louisiana
Latitude 30°23'45", Longitude 91°02'21" NAD27
Gage datum 37.00 feet above sea level NGVD29
The depth of the well is 1,078 feet below land surface. The depth of the hole is 1,078 feet below land surface.
This well is completed in 1000-FOOT SAND OF BATON ROUGE AREA (12110BR)

Date	Time	Water level, feet below land surface	Status
1937-01-10		-10.25	

USGS 302308091052903 EB- 198C

East Baton Rouge County, Louisiana
Latitude 30°23'08", Longitude 91°05'29" NAD27
Gage datum 33.00 feet above sea level NGVD29
The depth of the well is 1,650 feet below land surface. The depth of the hole is 1,650 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Status
1939-08-19		F

USGS 302515091055001 EB- 227

East Baton Rouge County, Louisiana
Latitude 30°25'15", Longitude 91°05'50" NAD27
Gage datum 47.00 feet above sea level NGVD29
The depth of the well is 1,300 feet below land surface. This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time		Status
1917-01-01			F

USGS 302443091043601 EB- 274

East Baton Rouge County, Louisiana
Latitude 30°24'43", Longitude 91°04'36" NAD27
Gage datum 45.00 feet above sea level NGVD29
The depth of the well is 1,430 feet below land surface. The depth of the hole is 1,434 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1921-05-30		-45.00	

USGS 302439091065401 EB- 326

East Baton Rouge County, Louisiana
Latitude 30°24'39", Longitude 91°06'54" NAD27
Gage datum 35.00 feet above sea level NGVD29
The depth of the well is 1,480 feet below land surface. The depth of the hole is 1,525 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1936-10-20		-29.00	

USGS 302436091043802 EB- 400A

East Baton Rouge County, Louisiana
Latitude 30°24'36", Longitude 91°04'38" NAD27
Gage datum 32.00 feet above sea level NGVD29
The depth of the well is 2,741 feet below land surface. The depth of the hole is 2,775 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status
1947-04-15		-41.60	

USGS 302436091043803 EB- 400B

East Baton Rouge County, Louisiana
Latitude 30°24'36", Longitude 91°04'38" NAD27
Gage datum 32.00 feet above sea level NGVD29
The depth of the well is 3,044 feet below land surface. The depth of the hole is 3,059 feet below land surface.
This well is completed in 2800-FOOT SAND OF BATON ROUGE AREA (12228BR)

Date	Time	Water level, feet below land surface	Status
1947-01-08		-97.00	

USGS 302436091043801 EB- 400C

East Baton Rouge County, Louisiana
Latitude 30°24'36", Longitude 91°04'38" NAD27
Gage datum 32.00 feet above sea level NGVD29
The depth of the well is 2,350 feet below land surface. The depth of the hole is 2,775 feet below land surface.
This well is completed in 2000-FOOT SAND OF BATON ROUGE AREA (12220BR)

Date	Time	Water level, feet below land surface	Status
1947-04-15		-42.70	

USGS 302634091022201 EB- 584

East Baton Rouge County, Louisiana
Latitude 30°26'34", Longitude 91°02'22" NAD27
Gage datum 40.00 feet above sea level NGVD29
The depth of the well is 1,414 feet below land surface. The depth of the hole is 1,428 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1961-04-13		21.75	

USGS 302553091034101 EB- 590

East Baton Rouge County, Louisiana
Latitude 30°25'53", Longitude 91°03'41" NAD27
Gage datum 48.00 feet above sea level NGVD29
The depth of the well is 1,441 feet below land surface. The depth of the hole is 1,446 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1956-06-07		18.00	

USGS 302711091025501 EB- 591

East Baton Rouge County, Louisiana
Latitude 30°27'11", Longitude 91°02'55" NAD27
Gage datum 43.00 feet above sea level NGVD29
The depth of the well is 1,374 feet below land surface. The depth of the hole is 1,380 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1965-10-20		39.63	

USGS 302500091052501 EB- 621

East Baton Rouge County, Louisiana. Latitude 30°25'00", Longitude 91°05'25" NAD27
Gage datum 33.00 feet above sea level NGVD29. The depth of the well is 1,487 feet below land surface. The depth of the hole is 1,490 feet below land surface. This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1957-01-04		10.42	
1990-05-16		72.92	

USGS 302630091031801 EB- 622

East Baton Rouge County, Louisiana
Latitude 30°26'30", Longitude 91°03'18" NAD27
Gage datum 41.00 feet above sea level NGVD29
The depth of the well is 1,420 feet below land surface. The depth of the hole is 1,439 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1957-01-04		15.53	

USGS 302606091030301 EB- 749

East Baton Rouge County, Louisiana
Latitude 30°26'06", Longitude 91°03'03" NAD27
Gage datum 37.00 feet above sea level NGVD29
The depth of the well is 1,403 feet below land surface. The depth of the hole is 1,408 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1962-07-03		25.23	

USGS 302306091022601 EB- 803A

East Baton Rouge County, Louisiana. Latitude 30°23'06", Longitude 91°02'26" NAD27
Gage datum 27.00 feet above sea level NGVD29. The depth of the well is 1,975 feet below land surface. The depth of the hole is 3,203 feet below land surface. This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1971-10-04		2.52	
				1971-11-10		2.41	
1966-04-04		-13.40		1972-04-13		0.38	
1966-04-20		-13.20		1972-10-11		4.44	
1966-04-29		-15.00		1972-10-30		4.56	
1966-05-06		-15.20		1972-11-01		4.55	
1966-05-18		-15.30		1973-04-09		1.67	
1966-05-26		-14.10		1973-06-12		2.18	
1966-06-10		-15.20		1973-07-16		4.72	
1966-06-24		-13.30		1973-10-10		0.57	
1966-07-26		-12.60		1974-05-02		4.39	

USGS 302306091022601 EB- 803A

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1966-08-02		-12.10		1974-09-26		6.89	
1966-08-15		-14.10		1974-11-01		6.29	

USGS 302306091022601 EB- 803A

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1966-08-23		-11.70		1975-04-01		-0.91	
1966-08-29		-12.30		1975-05-22		-1.09	
1966-09-06		-11.40		1975-11-05		4.26	
1966-09-12		-11.60		1975-11-17		2.11	
1966-09-19		-11.70		1975-12-15		0.09	
1966-09-26		-10.80		1976-04-19		0.86	
1966-10-10		-11.30		1976-04-26		5.12	
1966-10-31		-12.30		1976-05-21		6.03	
1966-11-14		-12.10		1976-05-26		9.48	
1966-11-21		-12.00		1976-11-11		4.28	
1966-11-28		-11.90		1976-12-15		0.64	
1966-12-05		-11.90		1977-04-07		11.15	
1966-12-13		-11.70		1977-06-01		11.36	
1966-12-20		-10.80		1977-11-10		12.60	
1966-12-27		-10.50		1978-04-04		12.45	
1967-01-03		-10.50		1978-04-19		12.31	
1967-01-16		-10.20		1978-11-07		14.46	
1967-01-23		-10.30		1978-12-20		14.28	
1967-01-31		-10.30		1979-05-17		13.64	
1967-06-09		-10.70		1979-06-08		14.05	
1967-07-05		-10.10		1979-11-08		15.76	
1967-08-11		-9.60		1979-11-27		15.69	
1967-09-13		-9.40		1980-05-06		14.34	
1967-10-10		-9.00		1980-06-03		14.59	
1967-12-20		-9.30		1980-11-20		16.00	

1968-02-29	-10.90	1981-04-03	15.92
1968-05-14	-10.20	1981-10-14	17.03
1968-07-22	-8.70	1981-10-19	17.19
1968-10-16	-8.50	1982-05-07	16.14
1969-04-24	-8.90	1982-10-22	17.69
1969-05-22	-6.81	1982-11-22	17.59
1969-05-26	-6.74	1983-03-29	16.59
1969-05-27	-7.30	1983-11-14	17.05
1969-10-20	-2.56	1983-12-01	17.09
1969-11-03	-3.34	1984-05-02	16.59
1970-01-07	-2.90	1984-10-02	17.78
1970-03-30	-4.53	1984-10-03	17.92
1970-04-13	-2.90	1985-10-21	17.49
1970-10-09	-0.79	1985-11-14	17.09
1970-11-02	-0.18	1986-04-18	16.59
1971-05-05	0.50	1990-05-09	7.49

USGS 302306091022602 EB- 803B

East Baton Rouge County, Louisiana
Latitude 30°23'06", Longitude 91°02'26" NAD27
Gage datum 27.00 feet above sea level NGVD29
The depth of the well is 2,565 feet below land surface. The depth of the hole is 3,203 feet below land surface.
This well is completed in 2000-FOOT SAND OF BATON ROUGE AREA (12220BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1972-04-13		-34.10	
				1972-10-11		-31.10	
1966-04-04		-53.10		1972-10-30		-31.20	
1966-04-20		-52.90		1972-11-01		-31.10	
1966-04-29		-52.70		1973-04-09		-32.60	
1966-05-06		-52.90		1973-06-12		-32.70	
1966-05-18		-52.70		1973-07-16		-33.80	
1966-05-26		-52.40		1973-10-10		-30.70	
1966-06-10		-51.70		1973-11-07		-29.40	
1966-06-24		-51.70		1974-05-02		-30.90	
1966-07-26		-51.70		1974-09-26		-29.10	
1966-08-02		-50.80		1974-11-01		-30.60	
1966-08-15		-52.70		1975-04-01		-29.20	
1966-08-23		-50.30		1975-05-22		-29.20	
1966-08-29		-50.30		1975-11-05		-28.20	
1966-09-06		-51.60		1975-11-17		-26.60	
1966-09-12		-50.60		1976-04-19		-28.20	
1966-09-19		-50.20		1976-04-26		-28.00	
1966-09-26		-50.30		1976-05-21		-27.60	
1966-10-10		-49.90		1976-11-11		-24.80	

1966-10-31	-50.50	1977-04-07	-25.60
1966-11-14	-49.50	1977-11-21	-23.20
1966-11-21	-49.40	1978-04-04	-24.20
1966-11-28	-48.80	1978-11-07	-16.00
1966-12-05	-49.10	1979-05-17	-20.00
1966-12-13	-48.80	1979-11-08	-19.40
1966-12-20	-49.10	1979-11-27	-20.60
1966-12-27	-48.90	1980-05-06	-19.40
1967-01-03	-48.80	1981-01-26	-18.00
1967-01-16	-48.60	1981-04-03	-18.20
1967-01-23	-48.80	1981-10-14	-17.80
1967-01-31	-48.60	1981-10-19	-19.20
1967-06-09	-48.70	1982-05-07	-11.60
1967-07-05	-48.90	1982-10-22	-18.60
1967-08-11	-47.70	1982-11-22	-18.00
1967-09-13	-47.50	1983-03-29	-19.60
1967-10-10	-46.60	1983-11-14	-19.80
1967-12-20	-47.10	1983-12-01	-19.40

USGS 302306091022602 EB- 803B

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1968-02-29		-47.30		1984-05-02		-21.60	
1968-05-14		-47.20		1984-10-03		-22.40	
1968-07-22		-45.60		1985-10-21		-18.20	
1968-10-16		-44.40		1986-04-18		-23.20	
1969-04-24		-43.10		1987-05-01		-19.20	
1969-05-27		-43.10		1987-09-28		-21.20	
1969-10-20		-40.70		1987-10-19		-18.20	
1969-11-03		-37.20		1988-05-26		-20.80	
1970-01-07		-39.20		1988-12-15		-15.80	
1970-03-30		-39.20		1989-12-05		-16.50	
1970-04-13		-36.20		1990-05-09		-19.80	
1970-10-09		-35.80		1990-09-19		-17.70	
1970-11-02		-36.60		1992-01-22		-19.40	
1971-05-05		-37.30		1992-10-16		-16.07	
1971-10-04		-33.80		1996-01-12		-12.90	
1971-11-04		-33.60		1997-05-20		-12.00	

USGS 302428091035002 EB- 804B

East Baton Rouge County, Louisiana

Latitude 30°24'28", Longitude 91°03'50" NAD27

Gage datum 46.00 feet above sea level NGVD29

The depth of the well is 2,762 feet below land surface. The depth of the hole is 2,862 feet below land surface.

This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1985-11-18		81.63	
1966-04-04		33.82		1986-10-27		91.76	
1966-04-20		33.94		1987-04-27		73.52	

1966-04-29		33.14		1987-07-20		84.70	
1966-05-06		32.45		1987-10-19		85.99	
1966-05-18		32.45		1988-05-26		91.35	
1966-05-26		33.46		1988-12-14		86.53	
1966-06-10		35.17		1989-01-24		87.12	
1966-06-24		36.54		1989-03-30		89.27	
1966-07-25		38.45		1989-07-12		88.75	
1966-08-02		38.91		1989-11-14		90.26	
1966-08-15		39.47		1989-12-05		87.34	
1966-08-23		39.80		1989-12-06		87.08	
1966-08-29		40.02		1990-02-16		82.91	
1966-09-06		40.26		1990-04-17		81.96	

USGS 302428091035002 EB- 804B

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1966-09-12		40.39		1990-05-09		83.67	
1966-09-19		40.61		1990-06-04		86.60	
1966-09-26		40.66		1990-07-10		93.49	
1966-10-10		40.66		1990-09-24		100.35	
1966-10-31		41.08		1990-11-01		97.75	
1966-11-14		41.82		1991-01-24		90.43	
1966-11-21		42.14		1991-05-01		90.08	
1966-11-28		42.24		1991-07-12		89.43	
1966-12-05		42.24		1991-10-24		98.42	
1966-12-13		42.44		1992-01-23		93.29	
1966-12-27		42.51		1992-04-13		86.97	
1967-01-03		42.37		1992-07-30		100.13	
1967-01-16		42.29		1993-02-16		92.29	
1967-01-23		42.30		1993-05-03		95.18	
1967-01-31		42.32		1993-07-14		89.43	
1967-06-09		44.35		1993-09-14		104.38	
1967-07-05		46.22		1993-11-29		87.91	
1967-08-11		47.77		1994-01-14		91.23	
1967-09-13		48.13		1994-04-21		96.16	
1967-10-10		47.91		1994-07-25		90.41	
1967-12-20		49.62		1994-11-01		83.67	
1968-02-29		48.55		1994-11-17		89.21	
1968-07-22		52.66		1995-02-09		85.41	
1968-10-16		55.94		1995-06-15		102.71	
1969-04-28		59.50		1995-08-02		109.62	
1969-10-20		69.53		1995-10-30		105.25	
1969-11-03		69.64		1996-01-12		101.13	
1970-01-17		69.67		1996-04-22		97.08	
1970-03-30		59.98		1996-07-08		106.09	
1970-10-09		72.63		1996-10-08		101.14	
1970-11-03		76.03		1996-12-11		98.83	
1971-05-06		78.27		1997-02-11		98.27	
1971-10-04		83.55		1997-05-01		94.96	
1971-11-08		83.65		1997-07-24		104.55	

1971-12-08		80.79		1997-11-11		104.51	
1972-04-13		79.15		1998-01-16		98.92	
1972-10-10		80.65		1998-01-23		98.92	
1973-04-09		79.64		1998-04-08		99.28	
1973-10-10		87.49		1998-07-24		111.20	
1973-10-30		88.20		1998-11-06		112.74	
1974-05-17		85.95		1998-12-14		107.22	
1974-09-26		87.45		1999-02-08		103.72	
1974-10-24		87.31		1999-05-05		109.25	

USGS 302428091035002 EB- 804B

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1975-04-01		83.13		1999-07-26		110.62	
1975-11-05		84.99		1999-11-17		113.62	
1975-11-14		84.96		1999-12-08		107.98	
1976-04-19		81.49		2000-02-11		107.21	
1976-11-11		87.69		2000-05-15		116.28	
1976-12-10		88.13		2000-10-20		130.24	
1977-04-06		85.77		2000-11-29		123.76	
1977-10-31		87.73		2001-01-17		123.00	
1978-04-04		87.93		2001-04-09		118.74	
1978-11-07		98.29		2001-07-09		129.39	
1978-11-29		98.66		2001-11-15		128.05	
1979-05-17		98.70		2001-12-18		119.96	
1979-11-08		102.76		2002-02-19		114.00	
1979-12-17		98.74		2002-05-16		122.20	
1980-05-06		93.38		2002-08-01		119.93	
1980-11-10		103.10		2002-10-21		121.81	
1981-04-01		97.75		2003-01-13		111.82	
1981-10-14		99.55		2003-02-12		112.10	
1981-10-21		99.48		2003-04-11		112.12	
1982-05-03		91.72		2003-07-07		119.40	
1982-10-22		92.93		2003-10-02		123.77	
1982-11-24		91.68		2003-11-20		117.55	
1983-03-29		88.48		2004-01-13		114.13	
1983-11-14		83.22		2004-04-02		110.79	
1983-12-07		84.17		2004-07-26	08:54	119.36	
1984-05-02		85.78		2004-10-01	10:12	127.87	
1984-10-02		89.22					
1984-10-04		89.35					
1985-10-21		80.53					

USGS 302721091054701 EB- 878

East Baton Rouge County, Louisiana
Latitude 30°27'21", Longitude 91°05'47" NAD27
Gage datum 50.00 feet above sea level NGVD29
The depth of the well is 2,178 feet below land surface. The depth of the hole is 2,191 feet below land surface.
This well is completed in 2000-FOOT SAND OF BATON ROUGE AREA (12220BR)

Date	Time	Water level, feet below	Status

Date	Time	Water level, feet below land surface	Status
1971-08-10		203.00	
2002-05-23		198.87	

USGS 302509091035301 EB- 990

East Baton Rouge County, Louisiana
Latitude 30°25'09", Longitude 91°03'53" NAD27
Gage datum 44.00 feet above sea level NGVD29
The depth of the well is 1,450 feet below land surface. The depth of the hole is 1,529 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1990-05-17		81.45	
2001-04-20		109.31	

USGS 302635091022201 EB-1003

East Baton Rouge County, Louisiana
Latitude 30°26'35", Longitude 91°02'22" NAD27
Gage datum 40.00 feet above sea level NGVD29
The depth of the well is 1,431. feet below land surface. The depth of the hole is 1,441 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
2001-04-20		96.90	

USGS 302537091032801 EB-1025

East Baton Rouge County, Louisiana
Latitude 30°25'37", Longitude 91°03'28" NAD27
Gage datum 45.00 feet above sea level NGVD29
The depth of the well is 2,674 feet below land surface. The depth of the hole is 2,678 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status
2002-05-23		125.62	

USGS 302518091041401 EB-1039

East Baton Rouge County, Louisiana
Latitude 30°25'18", Longitude 91°04'14" NAD27
Gage datum 40.00 feet above sea level NGVD29
The depth of the well is 2,697 feet below land surface. The depth of the hole is 2,710 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status
1984-03-02		101.00	

USGS 302514091055401 EB-1136

East Baton Rouge County, Louisiana
Latitude 30°25'14", Longitude 91°05'54" NAD27
Gage datum 47. feet above sea level NGVD29
The depth of the well is 1,405. feet below land surface. The depth of the hole is 1,445. feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1977-05-25		101.00	

USGS 302522091041901 EB-1287

East Baton Rouge County, Louisiana
Latitude 30°25'22", Longitude 91°04'19" NAD83
Gage datum 45. feet above sea level NGVD29
The depth of the well is 1,510. feet below land surface. The depth of the hole is 1,554. feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1998-07-14		107.	

USGS 302405091021901 EB-1295A

East Baton Rouge County, Louisiana
Latitude 30°24'05", Longitude 91°02'19" NAD83
Gage datum 40. feet above sea level NGVD29
The depth of the well is 1,820. feet below land surface. The depth of the hole is 1,870. feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1999-01-25		66.	

USGS 302521091041701 EB-1297

East Baton Rouge County, Louisiana
Latitude 30°25'21", Longitude 91°04'17" NAD83
Gage datum 45. feet above sea level NGVD29
The depth of the well is 1,635. feet below land surface. The depth of the hole is 1,650. feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)
Output formats

Date	Time	Water level, feet below land surface	Status
1999-08-13		112.	

GLEN OAKS HIGH SCHOOL

USGS 302747091093001 EB- 84

East Baton Rouge County, Louisiana. Latitude 30°27'47", Longitude 91°09'30" NAD27. Gage datum 57.00 feet above sea level NGVD29. The depth of the well is 1,590 feet below land surface. The depth of the hole is 1,595 feet below land surface. This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1943-10-27		7.54	
1927		-38.00		1943-11-23		9.17	
1927-01-01		-38.00		1943-12-21		3.69	
1943-02-23		-9.90		1944-01-25		5.24	
1943-04-20		-4.30		1944-02-19		-1.74	
1943-05-04		-3.30		1944-03-27		-1.18	
1943-05-19		-2.30		1944-05-10		-2.20	
1943-06-03		-1.50		1944-06-20		4.15	
1943-06-22		-2.10		1944-08-22		-0.08	
1943-07-16		-1.80		1944-09-25		-0.40	
1943-08-05		1.21		1944-10-30		-0.77	
1943-08-27		-1.00		1944-12-11		-1.34	
1943-09-24		8.37		1945-04-09		-5.70	

USGS 302751091093202 EB- 86B

East Baton Rouge County, Louisiana
Latitude 30°27'51", Longitude 91°09'32" NAD27
Gage datum 59.00 feet above sea level NGVD29
The depth of the well is 2,186 feet below land surface. The depth of the hole is 2,195 feet below land surface.
This well is completed in 2000-FOOT SAND OF BATON ROUGE AREA (12220BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1943-12-21		8.58	
				1944-01-25		7.18	
1943-02-23		-9.60		1944-02-19		7.74	
1943-04-20		-3.90		1944-03-27		10.82	
1943-06-03		3.24		1944-05-10		11.85	
1943-07-16		6.20		1944-06-20		15.45	
1943-08-05		9.32		1944-08-22		18.78	
1943-08-27		11.45		1944-09-25		17.51	
1943-09-24		11.24		1944-10-30		19.09	
1943-10-27		10.34		1944-12-11		18.54	
1943-11-23		10.76		1945-04-09		4.39	

USGS 302750091092601 EB- 88

East Baton Rouge County, Louisiana
Latitude 30°27'50", Longitude 91°09'26" NAD27
Gage datum 57.00 feet above sea level NGVD29
The depth of the well is 2,142 feet below land surface. The depth of the hole is 2,142 feet below land surface.
This well is completed in 2000-FOOT SAND OF BATON ROUGE AREA (12220BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1943-12-21		7.47	
1943-02-23		-6.90		1944-01-25		5.90	
1943-04-19		-1.70		1944-02-19		7.40	
1943-06-03		2.00		1944-03-27		9.36	
1943-06-22		3.88		1944-05-11		10.90	
1943-07-16		4.67		1944-06-20		13.57	
1943-08-05		8.17		1944-08-22		17.21	
1943-08-27		9.67		1944-09-25		16.15	
1943-09-24		10.51		1944-10-30		18.12	
1943-10-27		9.44		1944-12-11		16.87	
1943-11-23		9.20		1945-04-09		3.27	

USGS 302751091092501 EB- 89

East Baton Rouge County, Louisiana
Latitude 30°27'51", Longitude 91°09'25" NAD27
Gage datum 57.00 feet above sea level NGVD29
The depth of the well is 1,605 feet below land surface. The depth of the hole is 1,612 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1949-02-25		14.00	
1927-05-03		-35.20		1949-02-28		13.90	
1943-02-23		-6.10		1949-03-05		22.80	
1943-04-19		-3.60		1949-03-10		21.90	
1943-05-04		-4.60		1949-03-24		19.66	
1943-05-19		-3.60		1949-04-07		18.93	
1943-06-03		-2.50		1949-04-14		18.72	
1943-06-22		-1.30		1949-04-16		19.76	
1943-07-16		-2.20		1949-04-28		15.62	
1943-08-05		-0.62		1949-05-05		16.82	
1943-08-27		-1.70		1949-05-12		18.12	
1943-09-24		4.52		1949-05-19		27.03	
1943-10-27		5.24		1949-05-20		28.10	
1943-11-23		6.19		1949-05-25		28.20	
1943-12-21		3.80		1949-05-31		28.40	

USGS 302751091092501 EB- 89

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1944-01-25		3.05		1949-06-10		29.50	
1944-02-19		-0.50		1949-06-15		29.30	
1944-04-27		-0.72		1949-06-20		29.90	
1944-05-11		-1.40		1949-06-25		30.50	
1944-06-20		1.46		1949-06-30		30.70	
1944-08-22		1.44		1949-07-05		31.70	
1944-09-25		0.60		1949-07-10		33.30	
1944-10-31		1.50		1949-07-15		33.70	
1944-12-11		0.17		1949-07-20		34.20	
1945-04-09		-4.30		1949-07-25		33.90	
1947-11-18		9.30		1949-07-31		32.40	
1947-11-19		9.40		1949-08-05		20.40	
1947-11-20		9.30		1949-08-10		31.00	
1947-11-21		9.40		1949-08-15		29.80	
1947-11-22		9.50		1949-08-20		30.30	
1947-11-23		9.60		1949-08-25		30.00	
1947-11-24		9.70		1949-08-31		30.30	
1947-11-25		10.00		1949-09-05		32.30	
1947-11-26		10.10		1949-09-10		32.90	
1947-11-27		10.20		1949-09-15		33.50	
1947-11-28		9.30		1949-09-20		33.70	
1947-11-29		9.30		1949-09-25		34.00	
1947-11-30		9.30		1949-09-30		34.50	
1947-12-05		9.40		1949-10-05		34.40	
1947-12-15		23.30		1949-10-10		34.80	
1947-12-20		23.60		1949-10-15		35.00	
1947-12-25		23.40		1949-10-20		35.20	
1947-12-31		23.10		1949-10-25		35.20	
1948-01-05		23.40		1949-10-31		34.90	
1948-01-10		23.50		1949-11-05		35.00	
1948-01-15		23.60		1949-11-10		35.10	
1948-01-20		13.10		1949-11-15		35.10	
1948-01-27		21.18		1949-11-20		35.20	
1948-02-05		12.60		1949-11-25		35.20	
1948-02-10		12.30		1949-11-30		35.60	
1948-02-15		11.90		1949-12-05		35.80	
1948-02-20		11.60		1949-12-10		35.40	
1948-02-25		11.30		1949-12-15		36.60	
1948-02-29		11.20		1949-12-20		32.70	
1948-03-05		11.10		1949-12-25		34.90	
1948-03-10		10.80		1949-12-31		35.00	
1948-03-15		10.80		1950-01-05		34.50	

USGS 302751091092501 EB- 89

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1948-03-20		10.90		1950-01-10		34.40	
1948-03-25		10.90		1950-01-15		34.20	
1948-03-31		10.70		1950-01-20		34.30	
1948-04-05		10.80		1950-01-25		34.40	
1948-04-10		16.30		1950-01-31		34.50	
1948-04-15		11.20		1950-02-05		34.10	
1948-04-19		18.08		1950-02-10		34.00	
1948-04-20		17.90		1950-02-15		34.20	
1948-04-25		16.20		1950-02-20		34.10	
1948-04-26		16.16		1950-02-23		34.20	
1948-05-03		17.59		1950-02-25		34.00	
1948-05-10		18.11		1950-02-28		34.00	
1948-05-15		23.50		1950-03-05		33.90	
1948-05-20		23.30		1950-03-10		34.10	
1948-05-25		24.20		1950-03-15		33.70	
1948-05-31		24.30		1950-03-20		33.70	
1948-06-05		24.90		1950-03-25		34.00	
1948-06-10		26.00		1950-03-31		34.30	
1948-06-20		21.30		1950-04-05		34.30	
1948-06-25		23.00		1950-04-10		34.00	
1948-06-30		16.60		1950-04-15		34.20	
1948-07-05		20.70		1950-04-20		34.20	
1948-07-10		22.50		1950-04-25		34.20	
1948-07-15		20.80		1950-04-26		34.30	
1948-07-20		21.00		1950-04-30		34.40	
1948-07-25		17.20		1950-05-05		34.70	
1948-07-31		16.20		1950-05-10		41.20	
1948-08-05		15.70		1950-05-12		36.10	
1948-08-10		14.90		1950-05-15		35.00	
1948-08-20		21.00		1950-06-05		41.50	
1948-08-25		26.60		1950-06-10		42.00	
1948-08-31		23.70		1950-06-15		45.30	
1948-09-05		16.70		1950-06-20		47.70	
1948-09-10		16.80		1950-06-25		40.20	
1948-09-15		22.60		1950-06-30		45.40	
1948-09-20		23.00		1950-07-10		45.50	
1948-09-25		23.80		1950-07-15		45.10	
1948-09-30		26.00		1950-07-20		44.70	
1948-10-05		27.20		1950-07-25		44.60	
1948-10-10		27.80		1950-07-31		44.20	
1948-10-15		28.00		1950-08-05		44.00	
1948-10-25		25.30		1950-08-10		39.00	

USGS 302751091092501 EB- 89

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1948-10-31		19.50		1950-08-15		38.50	
1948-11-05		24.70		1950-08-20		38.50	
1948-11-10		24.60		1950-08-25		34.32	
1948-11-15		17.10		1950-09-05		38.70	
1948-12-05		15.20		1950-09-08		38.46	
1948-12-10		15.30		1950-10-13		47.71	
1948-12-15		15.00		1950-10-20		44.18	
1948-12-20		14.80		1950-10-31		44.50	
1948-12-25		14.60		1950-11-05		38.90	
1948-12-31		14.40		1950-11-10		38.80	
1949-01-05		14.30		1950-11-15		37.70	
1949-01-10		14.50		1950-11-20		37.00	
1949-01-15		14.20		1950-11-25		36.50	
1949-01-20		14.70		1950-11-30		40.80	
1949-01-25		14.30		1950-12-05		36.50	
1949-01-31		25.70		1950-12-10		36.30	
1949-02-05		16.80		1950-12-15		35.90	
1949-02-10		14.80		1950-12-20		41.60	
1949-02-15		14.50		1950-12-25		35.30	
1949-02-20		14.20		1950-12-31		37.70	

USGS 302746091091601 EB- 94

East Baton Rouge County, Louisiana. Latitude 30°27'46", Longitude 91°09'16" NAD27
Gage datum 56.00 feet above sea level NGVD29.
The depth of the well is 1,595 feet below land surface. The depth of the hole is 1,598 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1959-03-05		77.93	
				1959-03-10		77.94	
1940-10		-16.00		1959-03-15		74.32	
1940-10-01		-16.00		1959-03-20		77.82	
1943-02-23		-10.66		1959-03-25		78.50	
1943-04-19		-8.46		1959-03-31		79.08	
1943-05-04		-8.46		1959-04-04		80.23	
1943-05-19		-6.06		1959-04-05		76.71	
1943-06-03		-5.46		1959-04-10		80.70	
1943-06-22		-4.36		1959-04-15		80.65	
1943-07-16		-4.16		1959-04-20		79.08	

USGS 302746091091601 EB- 94

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1943-08-05		-2.66		1959-04-25		80.49	
1943-08-27		-2.36		1959-04-30		81.20	
1943-09-24		0.26		1959-05-05		82.33	
1943-10-27		1.28		1959-05-10		83.39	
1943-10-28		1.44		1959-05-14		82.25	
1943-11-23		2.53		1959-05-15		81.91	
1943-12-21		1.57		1959-05-20		82.09	
1944-01-25		-1.19		1959-05-25		80.17	
1944-02-19		-4.08		1959-05-31		77.80	
1944-03-27		-4.18		1959-06-01		81.54	
1944-05-11		-4.79		1959-06-05		82.04	
1944-06-20		-2.30		1959-06-10		81.03	
1944-09-25		-3.24		1959-06-15		78.84	
1944-10-30		-3.01		1959-06-20		81.64	
1944-12-11		-4.01		1959-06-25		81.20	
1945-04-09		-7.96		1959-06-30		84.22	
1958-07-29		76.37		1959-07-05		78.69	
1958-07-31		75.17		1959-07-06		83.08	
1958-08-05		76.46		1959-07-10		83.30	
1958-09-04		75.18		1959-07-15		83.10	
1958-09-05		76.65		1959-07-20		83.34	
1958-09-10		76.80		1959-07-25		82.80	
1958-09-11		77.10		1959-07-28		83.27	
1958-09-15		76.40		1959-07-31		83.05	
1958-09-20		77.12		1959-08-05		82.38	
1958-09-25		76.87		1959-08-10		82.18	
1958-09-30		75.06		1959-08-15		82.43	
1958-10-05		73.43		1959-08-20		72.20	
1958-10-08		76.10		1959-08-25		79.75	
1958-10-10		76.78		1959-08-31		80.39	
1958-10-15		77.78		1959-09-02		78.60	
1958-10-20		78.00		1959-09-05		80.15	
1958-10-25		79.05		1959-09-10		80.00	
1958-10-31		77.45		1959-09-15		78.80	
1958-11-04		77.79		1959-09-20		76.64	
1958-11-05		78.93		1959-09-25		80.75	
1958-11-10		79.05		1959-09-30		79.80	
1958-11-15		79.54		1959-10-05		80.40	
1958-11-20		80.07		1959-10-06		81.06	
1958-11-25		79.35		1959-10-10		80.70	
1958-11-30		75.16		1959-10-15		80.00	
1958-12-03		79.84		1959-10-20		79.40	
1958-12-05		79.06		1959-10-25		75.84	

USGS 302746091091601 EB- 94

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1958-12-10		75.66		1959-10-31		79.22	
1958-12-15		80.06		1959-11-02		79.38	
1958-12-20		78.67		1959-11-05		79.47	
1958-12-25		74.63		1959-11-10		79.50	
1958-12-31		71.03		1959-11-15		76.05	
1959-01-05		78.83		1959-11-20		79.20	
1959-01-10		79.54		1959-11-25		79.20	
1959-01-15		78.30		1959-11-30		78.55	
1959-01-20		78.55		1959-12-05		78.30	
1959-01-25		68.60		1959-12-07		78.08	
1959-01-31		76.10		1959-12-10		78.60	
1959-02-04		75.07		1959-12-15		79.30	
1959-02-05		78.67		1959-12-20		75.85	
1959-02-10		78.00		1959-12-25		75.80	
1959-02-15		74.39		1959-12-31		74.50	
1959-02-20		78.77		1960-01-05		77.45	
1959-02-25		76.37		1960-01-07		78.28	
1959-02-28		77.30		1960-01-10		74.89	
1959-03-03		75.61		1960-01-15		78.58	

USGS 302957091085101 EB- 105

East Baton Rouge County, Louisiana
Latitude 30°29'57", Longitude 91°08'51" NAD27
Gage datum 52.00 feet above sea level NGVD29
The depth of the well is 1,464 feet below land surface. The depth of the hole is 1,464 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1921-03-15		-52.00	

USGS 302756091092101 EB- 121

East Baton Rouge County, Louisiana
Latitude 30°27'56", Longitude 91°09'21" NAD27
Gage datum 55.00 feet above sea level NGVD29
The depth of the well is 1,570 feet below land surface. The depth of the hole is 1,570 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1920-02-07		-46.00	

USGS 302750091091501 EB- 133

East Baton Rouge County, Louisiana
Latitude 30°27'50", Longitude 91°09'15" NAD27
Gage datum 57.00 feet above sea level NGVD29
The depth of the well is 2,553 feet below land surface. The depth of the hole is 2,712 feet below land surface.
This well is completed in 2000- AND 2400-FT SANDS OF BATON ROUGE AREA, MIOCENE AGE (12223BR)

Date	Time	Water level, feet below land surface	Status
1944-10-31		15.20	

USGS 302852091061701 EB- 135

East Baton Rouge County, Louisiana
Latitude 30°28'52", Longitude 91°06'17" NAD27
Gage datum 55.00 feet above sea level NGVD29
The depth of the well is 1,429 feet below land surface. The depth of the hole is 1,429 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1938-05-30		-35.00	

USGS 302848091092401 EB- 153

East Baton Rouge County, Louisiana
Latitude 30°28'48", Longitude 91°09'24" NAD27
Gage datum 60.00 feet above sea level NGVD29
The depth of the well is 1,562 feet below land surface. The depth of the hole is 1,562 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1919		-45.00	

USGS 302908091093101 EB- 154

East Baton Rouge County, Louisiana
Latitude 30°29'08", Longitude 91°09'31" NAD27
Gage datum 61.00 feet above sea level NGVD29
The depth of the well is 2,434 feet below land surface. The depth of the hole is 2,474 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status
1942-03-15		-65.00	

USGS 302927091051701 EB- 307

East Baton Rouge County, Louisiana
Latitude 30°29'27", Longitude 91°05'17" NAD27
Gage datum 44.63 feet above sea level NGVD29
The depth of the well is 1,161 feet below land surface. The depth of the hole is 1,166 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1944-02-18		-21.70	
				1944-03-28		-22.90	
1926-02-23		-45.00		1944-05-05		-21.90	
1943-02-25		-24.80		1944-06-19		-21.70	
1943-04-21		-24.80		1944-08-19		-20.40	
1943-05-08		-23.00		1944-09-23		-20.00	
1943-05-19		-22.60		1944-10-31		-19.70	
1943-06-02		-22.80		1944-11-30		-19.90	
1943-06-21		-22.40		1945-01-15		-22.70	
1943-07-16		-21.60		1947-01-31		-16.00	
1943-08-05		-20.90		1947-07-09		-15.00	
1943-08-28		-20.40		1947-12-16		-13.80	
1943-09-23		-20.60		1948-05-12		-13.90	
1943-10-27		-20.20		1949-01-26		-11.00	
1943-11-20		-24.60		1949-11-02		-7.30	
1943-12-20		-23.90		1956-09-07		38.64	
1944-01-24		-22.20		1959-05-12		47.16	

USGS 302842091063801 EB- 308

East Baton Rouge County, Louisiana
Latitude 30°28'42", Longitude 91°06'38" NAD27
Gage datum 52.30 feet above sea level NGVD29
The depth of the well is 1,170 feet below land surface. This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1943-10-27		-11.40	
				1943-11-22		-13.00	
1915		-45.00		1943-12-20		-13.60	
1915-01-01		-45.00		1944-01-24		-10.40	
1943-02-25		-16.30		1944-02-19		-10.10	
1943-04-21		-15.40		1944-03-28		-11.20	
1943-05-08		-15.00		1944-05-10		-11.00	
1943-05-19		-15.00		1944-06-16		-11.00	
1943-06-21		-14.70		1944-08-19		-9.50	
1943-07-16		-13.10		1944-09-23		-9.20	
1943-08-05		-12.30		1944-10-31		-8.90	
1943-08-23		-11.30		1944-11-30		-9.20	
1943-09-22		-12.10		1945-07-15		-12.30	

USGS 302934091085401 EB- 312

East Baton Rouge County, Louisiana
Latitude 30°29'34", Longitude 91°08'54" NAD27
Gage datum 50.00 feet above sea level NGVD29
The depth of the well is 1,370 feet below land surface. The depth of the hole is 1,370 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1950-01-25		14.17	
				1950-02-01		13.85	
1925-02-20		-35.00		1950-02-08		13.77	
1943-02-23		-19.60		1950-02-27		14.00	
1943-04-20		-17.50		1950-03-02		13.94	
1943-05-07		-16.90		1950-03-09		13.93	
1943-05-19		-16.20		1950-03-17		13.63	
1943-06-03		-16.20		1950-03-23		13.83	
1943-06-21		-14.60		1950-03-30		14.31	
1943-07-17		-15.20		1950-04-06		14.22	
1943-08-05		-13.80		1950-04-13		14.27	
1943-08-27		-14.90		1950-04-20		14.05	
1943-09-22		-16.60		1950-04-27		14.28	
1943-10-28		-15.00		1950-05-04		14.61	
1943-11-22		-17.70		1950-05-12		15.83	
1943-12-23		-16.80		1950-05-19		15.84	
1944-02-18		-14.20		1950-05-26		16.93	
1944-03-25		-14.90		1950-06-02		18.94	
1944-05-08		-15.40		1950-06-09		16.51	
1944-06-17		-15.20		1950-06-17		19.08	
1944-08-10		-15.00		1950-06-22		19.73	
1944-08-21		-13.80		1950-06-30		19.65	
1944-10-27		-14.10		1950-07-07		19.52	
1944-12-01		-15.10		1950-07-13		19.70	
1945-02-23		-16.60		1950-07-20		19.64	
1945-03-02		-18.10		1950-07-27		19.09	
1945-03-09		-17.30		1950-08-03		18.97	
1945-04-07		-18.80		1950-08-11		18.54	
1945-05-13		-19.50		1950-08-18		17.72	
1945-05-28		-19.00		1950-08-25		17.67	
1945-06-30		-18.90		1950-09-01		18.90	
1945-07-24		-18.10		1950-09-08		18.53	
1945-07-26		-18.30		1950-09-15		19.46	
1945-08-03		-18.10		1950-09-22		19.54	
1945-08-10		-18.10		1950-09-29		18.85	
1945-09-24		-16.40		1950-10-06		18.45	
1946-06-15		-14.10		1950-10-13		19.42	
1946-07-10		-13.00		1950-10-20		19.07	
1946-07-17		-12.70		1950-10-27		19.08	
1946-07-26		-12.10		1950-11-03		19.01	
1946-08-17		-11.20		1950-11-10		18.28	
1946-08-23		-10.30		1950-11-17		16.25	

USGS 302934091085401 EB- 312

Date	Time	Water level, ft. bls	Status	Date	Time	Water level, ft. bls	Status
1946-09-07		-12.00		1950-11-22		15.80	
1946-11-14		-5.60		1950-12-01		15.58	
1946-12-16		-7.80		1950-12-08		16.42	
1946-12-24		-7.30		1950-12-15		15.12	
1947-01-02		-7.60		1950-12-22		15.68	
1947-01-10		-7.60		1950-12-29		14.10	
1947-01-20		-8.00		1951-01-05		13.90	
1947-01-24		-7.70		1951-01-12		13.63	
1947-01-31		-8.10		1951-01-22		12.99	
1947-03-05		-7.40		1951-01-29		12.56	
1947-05-04		-7.10		1951-02-02		16.68	
1947-05-09		-6.10		1951-02-09		15.75	
1947-06-06		-6.10		1951-02-16		14.36	
1947-07-09		-5.40		1951-02-23		13.68	
1947-07-31		-3.90		1951-03-02		13.33	
1947-09-04		-4.30		1951-03-09		13.10	
1947-09-16		-4.10		1951-03-25		11.93	
1947-11-23		-5.20		1951-03-29		11.69	
1947-12-17		-4.90		1951-04-05		11.20	
1948-03-06		-3.38		1951-04-12		11.78	
1948-03-15		-3.18		1951-04-19		11.88	
1948-03-28		-3.26		1951-04-26		12.01	
1948-04-11		-3.02		1951-05-03		12.17	
1948-05-01		-2.03		1951-05-10		12.04	
1948-05-16		0.29		1951-05-17		12.47	
1948-05-31		2.94		1951-05-24		15.66	
1948-06-16		4.94		1951-06-01		18.83	
1948-06-21		4.33		1951-06-08		20.99	
1948-06-25		4.39		1951-06-15		20.98	
1948-07-11		5.69		1951-07-18		23.97	
1948-07-28		4.92		1951-07-25		23.14	
1948-08-15		4.47		1951-08-01		22.62	
1948-08-28		6.05		1951-08-08		23.22	
1948-10-01		6.49		1951-08-15		23.51	
1948-10-15		7.46		1951-08-22		23.42	
1948-11-14		6.18		1951-08-29		24.19	
1948-12-31		3.21		1951-09-05		23.33	
1949-01-13		3.78		1951-09-12		22.01	
1949-02-04		4.40		1951-09-28		20.28	
1949-02-10		3.23		1951-10-04		20.03	
1949-02-17		2.80		1951-10-11		19.54	
1949-02-24		2.79		1951-10-18		20.23	
1949-03-03		2.16		1951-10-25		20.65	
1949-03-11		4.11		1951-11-02		20.72	
1949-03-17		4.30		1951-11-16		19.40	
1949-03-24		4.00		1951-11-21		19.21	
1949-03-31		3.43		1951-11-28		18.97	
1949-04-07		3.52		1951-12-06		18.52	
1949-04-14		3.56		1951-12-13		18.65	
1949-04-21		3.38		1951-12-20		18.87	

USGS 302934091085401 EB- 312

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1949-04-28		4.07		1951-12-27		18.93	
1949-05-05		5.23		1952-01-03		18.73	
1949-05-12		6.51		1952-01-10		18.78	
1949-05-19		8.53		1952-01-17		18.78	
1949-05-26		8.80		1952-01-24		18.98	
1949-06-02		9.08		1952-01-31		18.69	
1949-07-08		12.91		1952-02-07		18.00	
1949-07-28		14.43		1952-02-14		17.61	
1949-08-04		13.08		1952-02-21		16.73	
1949-08-11		11.41		1952-02-28		16.17	
1949-08-18		11.81		1952-03-06		16.13	
1949-08-25		11.45		1952-04-04		14.95	
1949-09-01		12.03		1952-05-08		18.00	
1949-09-08		13.10		1952-08-29		25.55	
1949-09-15		13.66		1952-09-24		25.13	
1949-09-22		13.89		1952-10-02		26.27	
1949-09-29		14.02		1952-10-09		26.22	
1949-10-06		14.47		1952-10-16		27.18	
1949-10-13		14.65		1952-10-23		26.91	
1949-10-20		14.98		1952-10-30		27.06	
1949-10-27		15.09		1952-11-06		26.37	
1949-11-03		14.77		1952-11-13		26.59	
1949-11-10		14.90		1952-11-20		26.00	
1949-11-23		15.07		1952-12-05		24.61	
1949-11-30		15.88		1952-12-11		24.73	
1949-12-07		16.08		1952-12-18		25.31	
1949-12-14		15.27		1952-12-24		24.69	
1949-12-21		14.90		1952-12-31		24.65	
1949-12-28		14.72		1953-01-08		24.81	
1950-01-04		14.35		1953-01-22		24.73	
1950-01-18		14.02		1953-02-06		25.04	

USGS 302820091072401 EB- 327

East Baton Rouge County, Louisiana
Latitude 30°28'20", Longitude 91°07'24" NAD27
Gage datum 55.00 feet above sea level NGVD29
The depth of the well is 1,236 feet below land surface. This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1986-08-19		112.55	
1972-05-16		100.96		1986-10-31		110.68	
1972-12-13		111.87		1987-04-27		106.35	

USGS 302820091072401 EB- 327

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1973-02-06		110.45		1987-09-04		109.92	
1973-05-23		110.53		1987-10-19		109.29	
1973-07-26		113.77		1988-02-29		103.28	
1973-10-10		111.58		1988-05-25		104.69	
1974-02-07		100.10		1988-10-12		104.26	
1974-05-17		110.15		1990-05-10		104.19	
1974-07-24		115.50		1992-09-04		114.81	
1974-10-04		112.45		1992-11-25		113.81	
1975-01-22		107.19		1993-03-25		114.80	
1975-03-28		102.27		1993-05-05		107.45	
1975-07-14		103.70		1993-07-12		113.85	
1975-11-03		106.13		1993-11-30		113.72	
1976-02-12		106.87		1994-04-25		107.81	
1976-04-15		107.13		1994-07-25		112.80	
1976-07-08		113.15		1994-11-21		114.71	
1976-11-09		112.74		1995-02-09		106.04	
1977-03-01		112.05		1995-06-14		107.92	
1977-04-08		112.69		1995-08-02		109.14	
1977-07-22		118.17		1995-10-27		109.67	
1977-11-17		114.27		1996-03-11		111.39	
1978-02-07		111.82		1996-04-22		111.40	
1978-04-07		110.15		1996-07-10		112.35	
1978-08-01		115.90		1996-10-08		111.36	
1978-11-07		118.39		1997-02-12		108.24	
1979-03-01		113.54		1997-04-30		108.54	
1979-05-17		110.92		1997-07-23		113.70	
1979-07-16		119.58		1997-11-11		118.48	
1979-11-07		114.83		1998-01-27		113.28	
1980-01-21		108.23		1998-04-08		112.68	
1980-05-07		112.28		1998-07-27		122.20	
1980-07-14		114.60		1998-11-16		124.58	
1980-10-28		117.06		1999-02-08		120.38	
1981-01-20		115.30		1999-05-04		123.43	
1981-04-01		116.15		1999-07-22		120.81	
1981-07-23		119.20		1999-11-16		122.98	
1981-10-08		118.07		2000-02-09		124.37	
1982-01-18		117.85		2000-07-17		133.31	
1982-05-03		114.56		2000-10-23		133.89	
1982-07-16		114.10		2001-01-17		121.72	
1982-10-08		111.74		2001-04-12		122.28	
1983-02-02		106.60		2001-07-05		131.43	
1983-04-12		103.00		2001-11-16		125.82	
1983-07-06		104.05		2002-02-19		128.01	
1983-11-14		108.53		2002-05-16		136.08	
1984-02-13		109.90		2002-08-06		132.29	
1984-05-09		110.85		2002-10-09		130.66	
1984-07-19		111.10		2003-02-14		126.95	
1984-10-02		111.00		2003-04-23		126.84	
1985-04-15		103.38		2003-07-02		140.28	
1985-08-09		112.20		2003-10-14		130.85	

USGS 302820091072401 EB- 327

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
1985-10-18		110.05					
1986-02-21		109.05					
1986-04-17		110.25					

USGS 302842091060801 EB- 328

East Baton Rouge County, Louisiana
Latitude 30°28'42", Longitude 91°06'08" NAD27
Gage datum 56.00 feet above sea level NGVD29
The depth of the well is 1,340 feet below land surface. The depth of the hole is 1,340 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1939-02-07		-33.50	

USGS 303131091072401 EB- 342

East Baton Rouge County, Louisiana
Latitude 30°31'31", Longitude 91°07'24" NAD27
Gage datum 60.00 feet above sea level NGVD29
The depth of the well is 1,140 feet below land surface. The depth of the hole is 1,140 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1937-07-15		-27.70	

USGS 303134091074601 EB- 343

East Baton Rouge County, Louisiana
Latitude 30°31'34", Longitude 91°07'46" NAD27
Gage datum 63.00 feet above sea level NGVD29
The depth of the well is 1,120 feet below land surface. The depth of the hole is 1,120 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1959-04-08		92.10	

USGS 302854091054601 EB- 348

East Baton Rouge County, Louisiana
Latitude 30°28'54", Longitude 91°05'46" NAD27
Gage datum 55.00 feet above sea level NGVD29
The depth of the well is 1,430 feet below land surface. The depth of the hole is 1,430 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1939-01-02		-32.30	

USGS 302854091054602 EB- 349

East Baton Rouge County, Louisiana
Latitude 30°28'54", Longitude 91°05'46" NAD27
Gage datum 55.00 feet above sea level NGVD29
The depth of the well is 1,130 feet below land surface. The depth of the hole is 1,155 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1935		-25.00	
1935-01-01		-25.00	

USGS 303126091083601 EB- 373

East Baton Rouge County, Louisiana
Latitude 30°31'26", Longitude 91°08'36" NAD27
Gage datum 68.00 feet above sea level NGVD29
The depth of the well is 1,370 feet below land surface. The depth of the hole is 1,371 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Status
1944-07-31		F

USGS 303052091091901 EB- 374

East Baton Rouge County, Louisiana
Latitude 30°30'52", Longitude 91°09'19" NAD27
Gage datum 63.00 feet above sea level NGVD29
The depth of the well is 1,409 feet below land surface. The depth of the hole is 1,409 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1949-07-08		21.80	

USGS 302958091085601 EB- 378

East Baton Rouge County, Louisiana
Latitude 30°29'58", Longitude 91°08'56" NAD27
Gage datum 54.00 feet above sea level NGVD29
The depth of the well is 2,777 feet below land surface. The depth of the hole is 2,777 feet below land surface.
This well is completed in 2800-FOOT SAND OF BATON ROUGE AREA (12228BR)

Date	Time	Water level, feet below land surface	Status
1953-03-06		-85.50	
1959-04-22		-55.20	
1972-06-21		-10.41	

USGS 302957091085102 EB- 443

East Baton Rouge County, Louisiana
Latitude 30°29'57", Longitude 91°08'51" NAD27
Gage datum 52.00 feet above sea level NGVD29
The depth of the well is 1,462 feet below land surface. The depth of the hole is 1,462 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Status
1946-08-23		F

USGS 302902091092201 EB- 447

East Baton Rouge County, Louisiana
Latitude 30°29'02", Longitude 91°09'22" NAD27
Gage datum 61.00 feet above sea level NGVD29
The depth of the well is 1,600 feet below land surface. The depth of the hole is 1,626 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1947-09-14		-2.00	

USGS 303102091081002 EB- 455

East Baton Rouge County, Louisiana
Latitude 30°31'02", Longitude 91°08'10" NAD27
Gage datum 62.00 feet above sea level NGVD29
The depth of the well is 1,165 feet below land surface. The depth of the hole is 1,592 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1947-08-10		6.65	

USGS 302845091081401 EB- 514B

East Baton Rouge County, Louisiana
Latitude 30°28'45", Longitude 91°08'14" NAD27
Gage datum 48.00 feet above sea level NGVD29
The depth of the well is 2,595 feet below land surface. The depth of the hole is 2,863 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status	Date	Time	Water level, feet below land surface	Status
				1955-03-30		19.47	
1954-03-12		8.01		1955-04-20		12.76	
1954-06-29		19.30		1955-05-25		21.82	
1954-08-09		21.74		1955-06-07		24.36	
1954-09-09		22.40		1955-07-07		26.29	
1954-10-05		22.47		1955-08-12		27.69	
1954-11-04		16.40		1955-09-13		30.18	
1954-12-15		12.84		1955-10-14		31.56	
1955-02-25		11.06		1955-11-23		31.51	

USGS 303021091080001 EB- 523

East Baton Rouge County, Louisiana
Latitude 30°30'21", Longitude 91°08'00" NAD27
Gage datum 59.00 feet above sea level NGVD29
The depth of the well is 1,206 feet below land surface. The depth of the hole is 1,206 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1959-03-10		105.61	
2001-04-25		133.52	

USGS 303019091074801 EB- 653

East Baton Rouge County, Louisiana
Latitude 30°30'19", Longitude 91°07'48" NAD27
Gage datum 58.00 feet above sea level NGVD29
The depth of the well is 1,153 feet below land surface. The depth of the hole is 1,220 feet below land surface.
This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1963-02-22		119.00	

USGS 303021091074801 EB- 654

East Baton Rouge County, Louisiana
Latitude 30°30'21", Longitude 91°07'48" NAD27
Gage datum 58.00 feet above sea level NGVD29
The depth of the well is 2,382 feet below land surface. The depth of the hole is 2,390 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status
1958-09-30		44.58	

USGS 303130091073101 EB- 700

East Baton Rouge County, Louisiana
Latitude 30°31'30", Longitude 91°07'31" NAD27
Gage datum 62.00 feet above sea level NGVD29
The depth of the well is 2,557 feet below land surface. The depth of the hole is 2,600 feet below land surface.
This well is completed in 2800-FOOT SAND OF BATON ROUGE AREA (12228BR)

Date	Time	Water level, feet below land surface	Status
1970-04-22		13.00	
1990-05-25		47.16	

USGS 303018091075601 EB- 718

East Baton Rouge County, Louisiana
Latitude 30°30'18", Longitude 91°07'56" NAD27
Gage datum 56.00 feet above sea level NGVD29
The depth of the well is 2,380 feet below land surface. The depth of the hole is 2,381 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status
1961-01-11		88.00	

USGS 302716091083801 EB- 751

East Baton Rouge County, Louisiana
Latitude 30°27'16", Longitude 91°08'38" NAD27. Gage datum 48.00 feet above sea level NGVD29
The depth of the well is 2,595 feet below land surface. The depth of the hole is 2,616 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status
1962-08-27		82.00	
2002-05-23		192.82	

USGS 303019091073701 EB- 756

East Baton Rouge County, Louisiana
Latitude 30°30'19", Longitude 91°07'37" NAD27
Gage datum 57.00 feet above sea level NGVD29
The depth of the well is 1,168 feet below land surface. This well is completed in 1200-FOOT SAND OF BATON ROUGE AREA (12112BR)

Date	Time	Water level, feet below land surface	Status
1962-06-29		105.86	
1990-05-17		112.08	

USGS 303021091073701 EB- 769

East Baton Rouge County, Louisiana
Latitude 30°30'21", Longitude 91°07'37" NAD27
Gage datum 55.00 feet above sea level NGVD29
The depth of the well is 2,362 feet below land surface. The depth of the hole is 2,804 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

Date	Time	Water level, feet below land surface	Status
1963-05-20		94.00	
2002-05-23		186.19	

USGS 302718091083901 EB- 774

East Baton Rouge County, Louisiana
Latitude 30°27'18", Longitude 91°08'39" NAD27
Gage datum 47.00 feet above sea level NGVD29
The depth of the well is 2,143 feet below land surface. The depth of the hole is 2,145 feet below land surface.
This well is completed in 2000-FOOT SAND OF BATON ROUGE AREA (12220BR)

Date	Time	Water level, feet below land surface	Status
1964-04-02		126.00	
1992-07-01		193.61	
2002-05-23		228.05	

USGS 302721091054801 EB- 873

East Baton Rouge County, Louisiana
Latitude 30°27'21", Longitude 91°05'48" NAD27. Gage datum 50.00 feet above sea level NGVD29
The depth of the well is 1,884 feet below land surface. The depth of the hole is 1,898 feet below land surface.
This well is completed in 1700-FOOT SAND OF BATON ROUGE AREA (12117BR)

Date	Time	Water level, feet below land surface	Status
2003-04-14		142.35	

USGS 302721091054701 EB- 878

East Baton Rouge County, Louisiana
Latitude 30°27'21", Longitude 91°05'47" NAD27
Gage datum 50.00 feet above sea level NGVD29
The depth of the well is 2,178 feet below land surface. The depth of the hole is 2,191 feet below land surface.
This well is completed in 2000-FOOT SAND OF BATON ROUGE AREA (12220BR)

Date	Time	Water level, feet below land surface	Status
1971-08-10		203.00	
2002-05-23		198.87	

USGS 302717091083901 EB- 927

East Baton Rouge County, Louisiana
Latitude 30°27'17", Longitude 91°08'39" NAD27
Gage datum 47.00 feet above sea level NGVD29
The depth of the well is 1,511 feet below land surface. The depth of the hole is 1,516 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1974-02-19		135.00	
2001-04-25		146.22	
2003-04-14		156.74	

USGS 303018091075602 EB- 928

East Baton Rouge County, Louisiana
Latitude 30°30'18", Longitude 91°07'56" NAD27 . Gage datum 56.00 feet above sea level NGVD29
The depth of the well is 2,375 feet below land surface. The depth of the hole is 2,383 feet below land surface.
This well is completed in 2400-FOOT SAND OF BATON ROUGE AREA (12224BR)

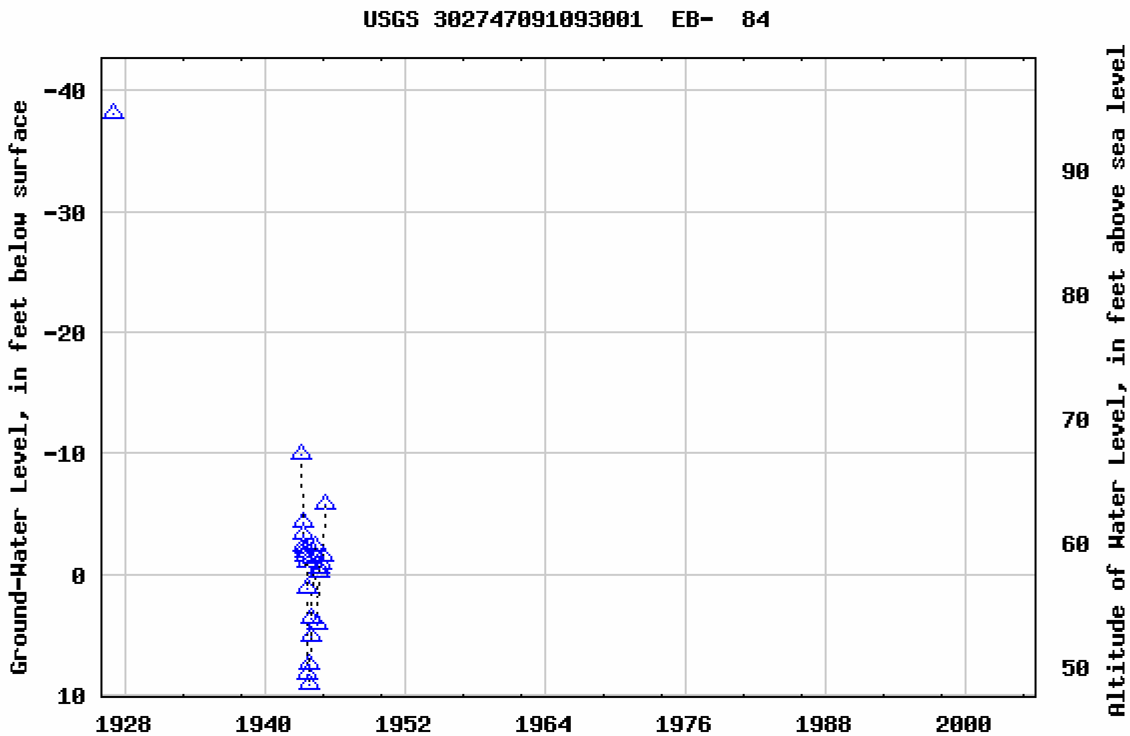
Date	Time	Water level, feet below land surface	Status
1974-02-20		204.00	
2002-05-23		193.25	

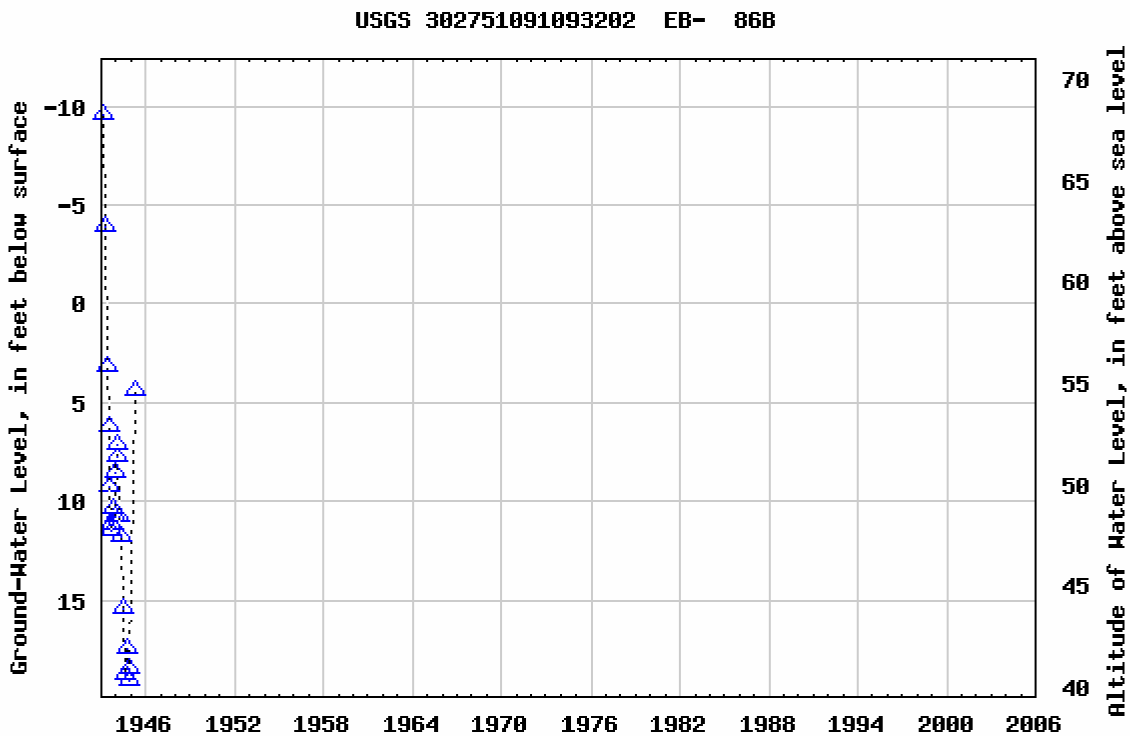
USGS 302717091051401 EB- 961

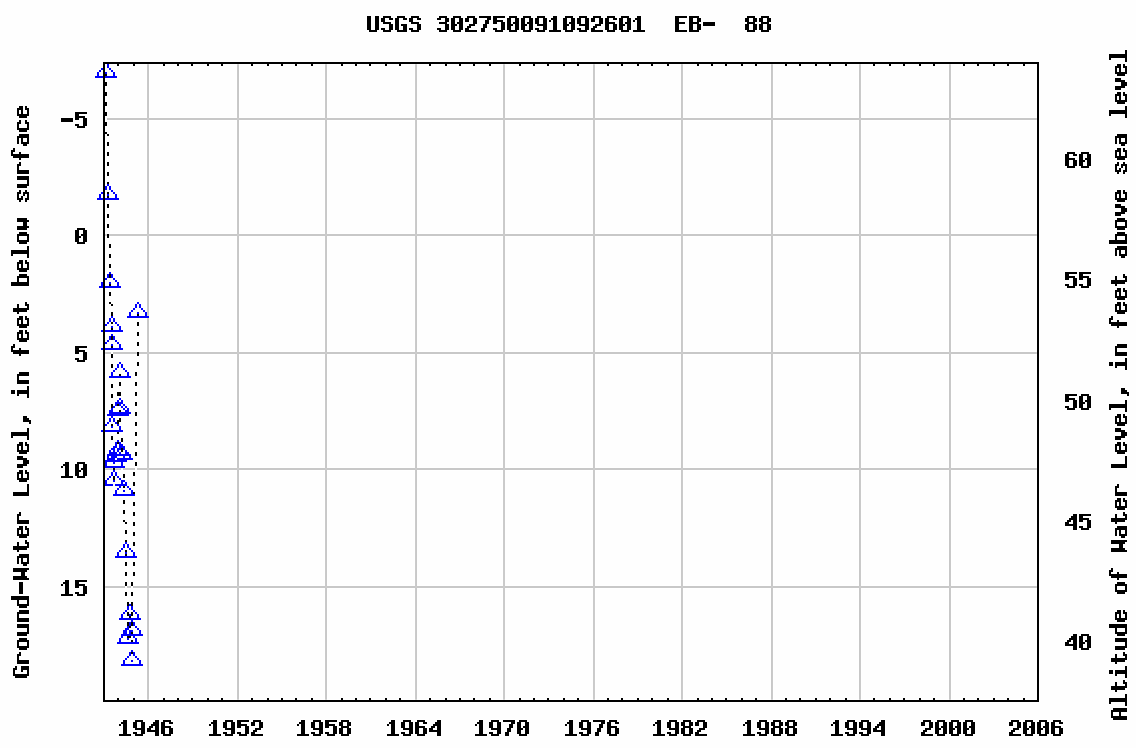
East Baton Rouge County, Louisiana
Latitude 30°27'17", Longitude 91°05'14" NAD27 . Gage datum 50.00 feet above sea level NGVD29
The depth of the well is 1,541 feet below land surface. The depth of the hole is 1,548 feet below land surface.
This well is completed in 1500-FOOT SAND OF BATON ROUGE AREA (12115BR)

Date	Time	Water level, feet below land surface	Status
1975-08-20		100.00	
1990-05-08		102.27	
2001-04-19		117.00	
2003-04-14		118.87	

APPENDIX H. HYDROGRAPHS FOR USGS WELLS



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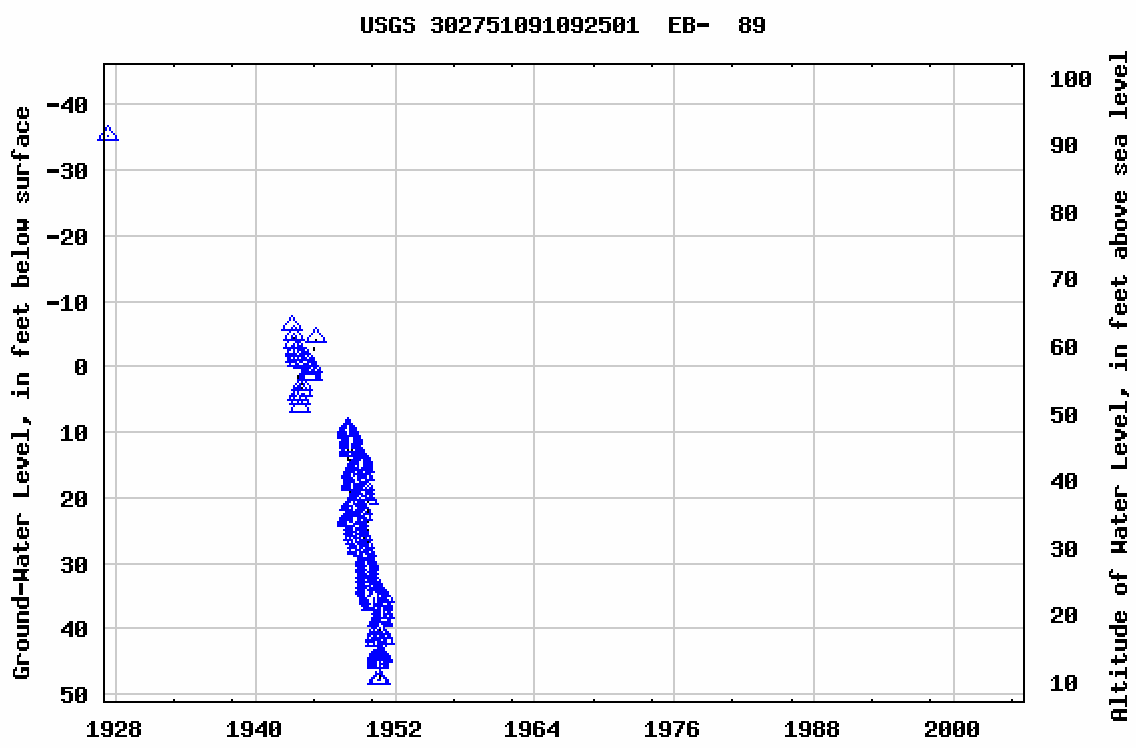
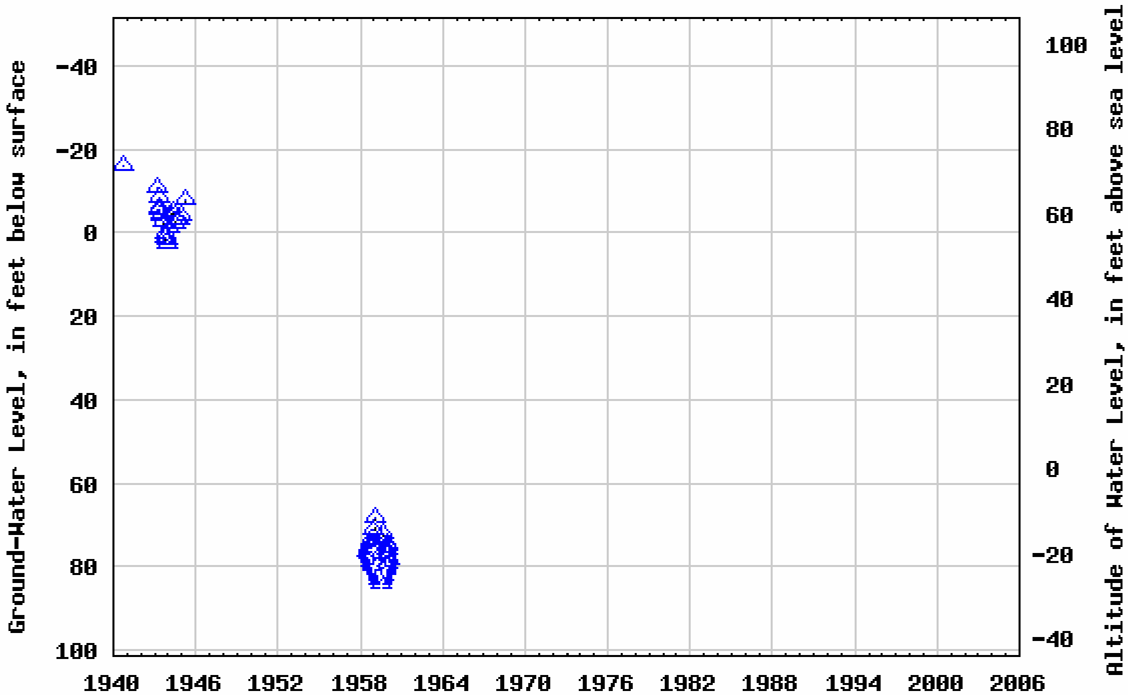
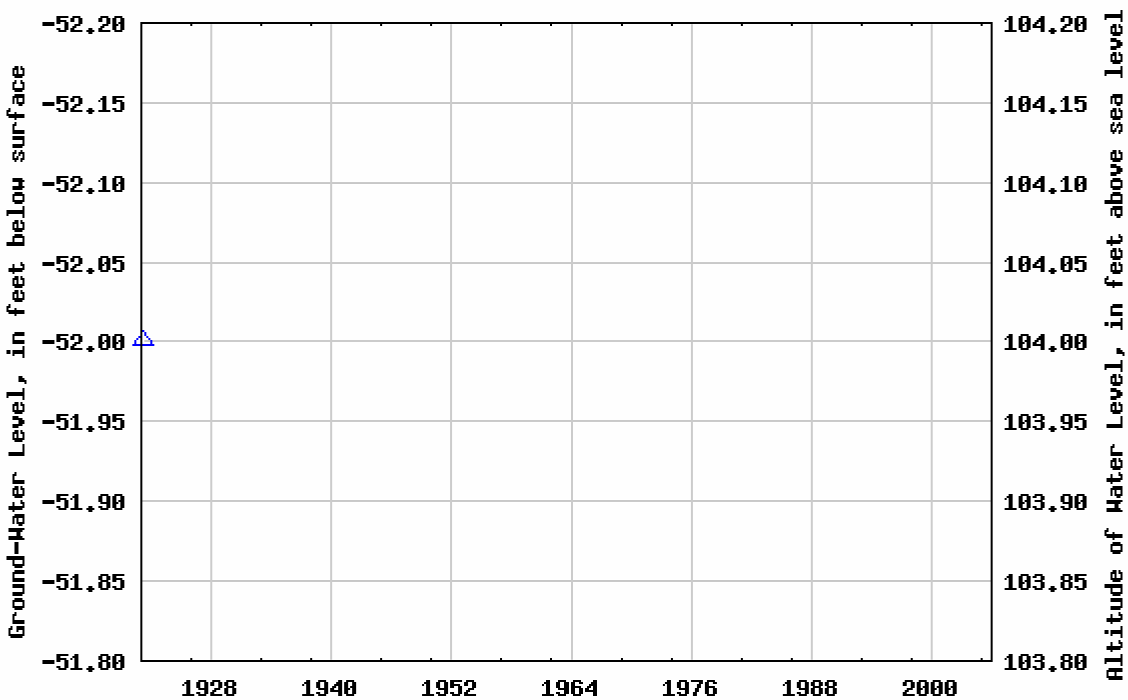
Ground-Water Level, in feet below surface
-5
0
5
10
15
1946
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006
Altitude of Water Level, in feet above sea level
60
55
50
45
40

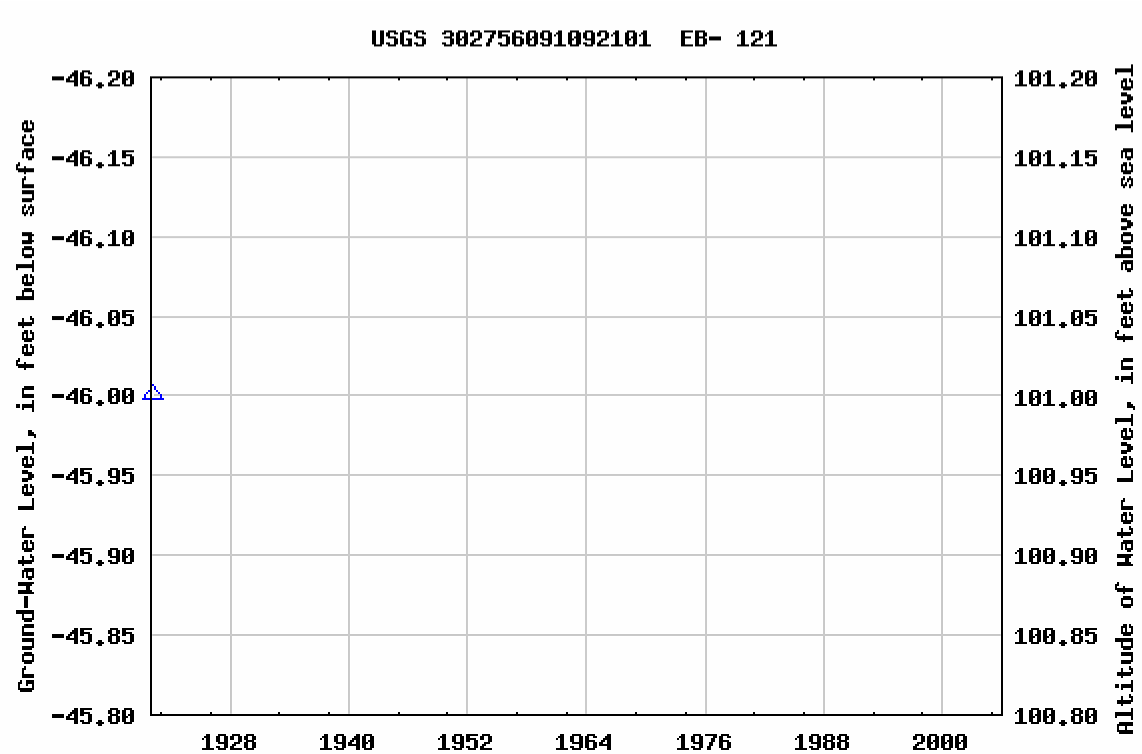

USGS 302751091092501 EB- 89
Ground-Water Level, in feet below surface
-40
-30
-20
-10
0
10
20
30
40
50
1928
1940
1952
1964
1976
1988
2000
Altitude of Water Level, in feet above sea level
100
90
80
70
60
50
40
30
20
10

USGS 302746091091601 EB- 94

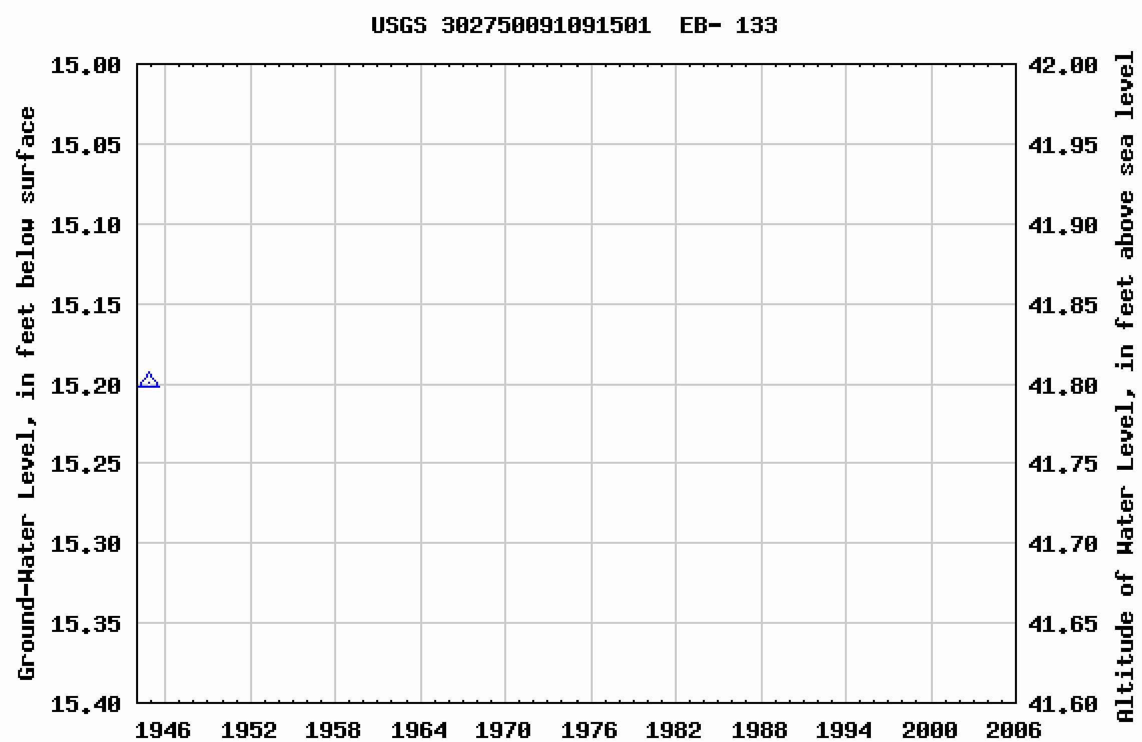


USGS 302957091085101 EB- 105

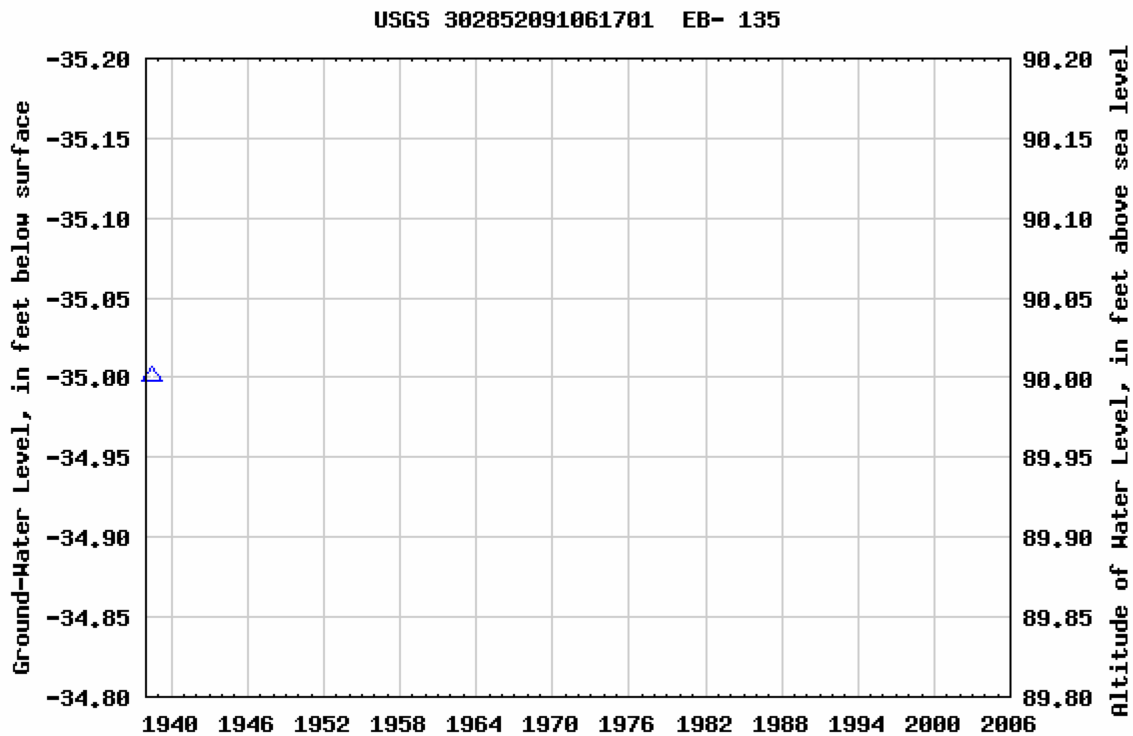




USGS 302756091092101 EB- 121
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-46.20
-46.15
-46.10
-46.05
-46.00
-45.95
-45.90
-45.85
-45.80
101.20
101.15
101.10
101.05
101.00
100.95
100.90
100.85
100.80
1928
1940
1952
1964
1976
1988
2000



USGS 302750091091501 EB- 133
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
15.00
15.05
15.10
15.15
15.20
15.25
15.30
15.35
15.40
42.00
41.95
41.90
41.85
41.80
41.75
41.70
41.65
41.60
1946
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006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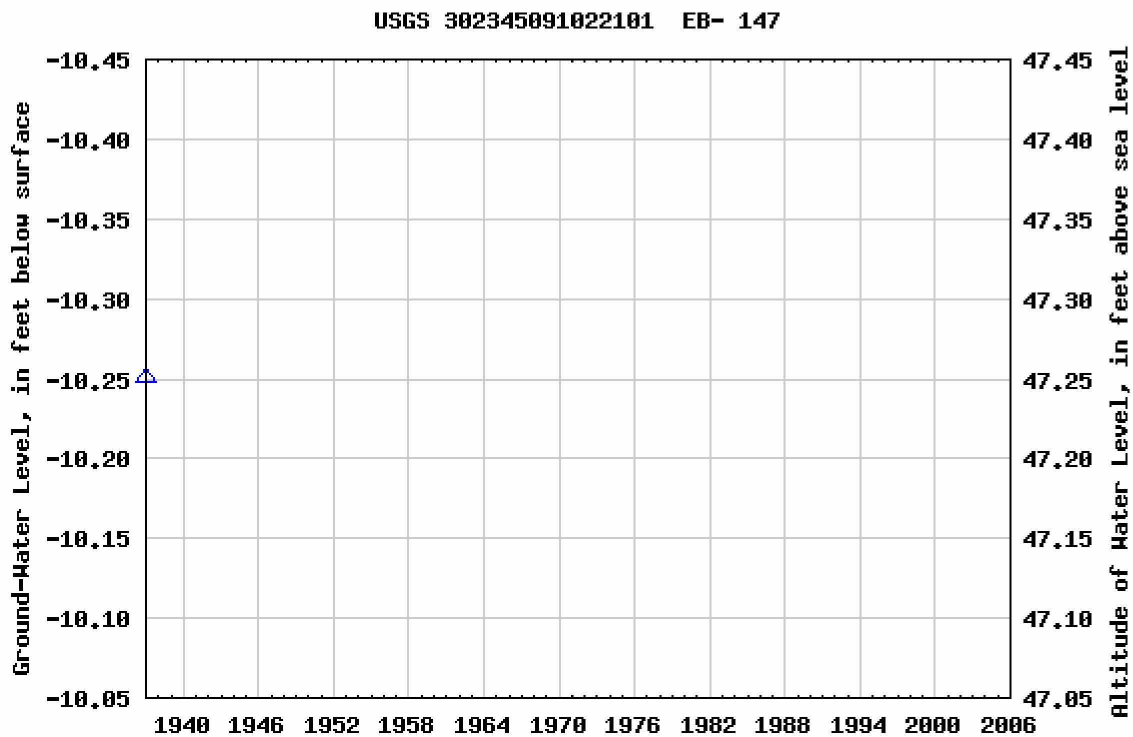
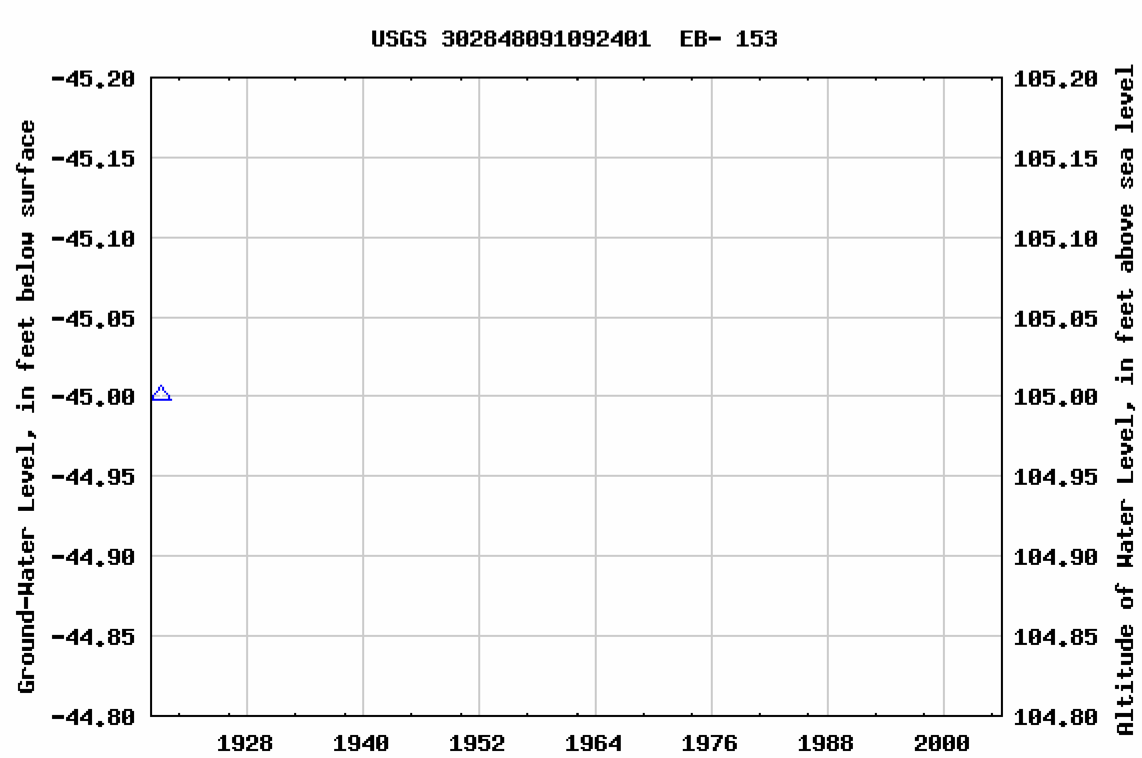
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-35.20
-35.15
-35.10
-35.05
-35.00
-34.95
-34.90
-34.85
-34.80
90.20
90.15
90.10
90.05
90.00
89.95
89.90
89.85
89.80
1940 1946 1952 1958 1964 1970 1976 1982 1988 1994 2000 2006


USGS 302345091022101 EB- 147
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-10.45
-10.40
-10.35
-10.30
-10.25
-10.20
-10.15
-10.10
-10.05
47.45
47.40
47.35
47.30
47.25
47.20
47.15
47.10
47.05
1940 1946 1952 1958 1964 1970 1976 1982 1988 1994 2000 2006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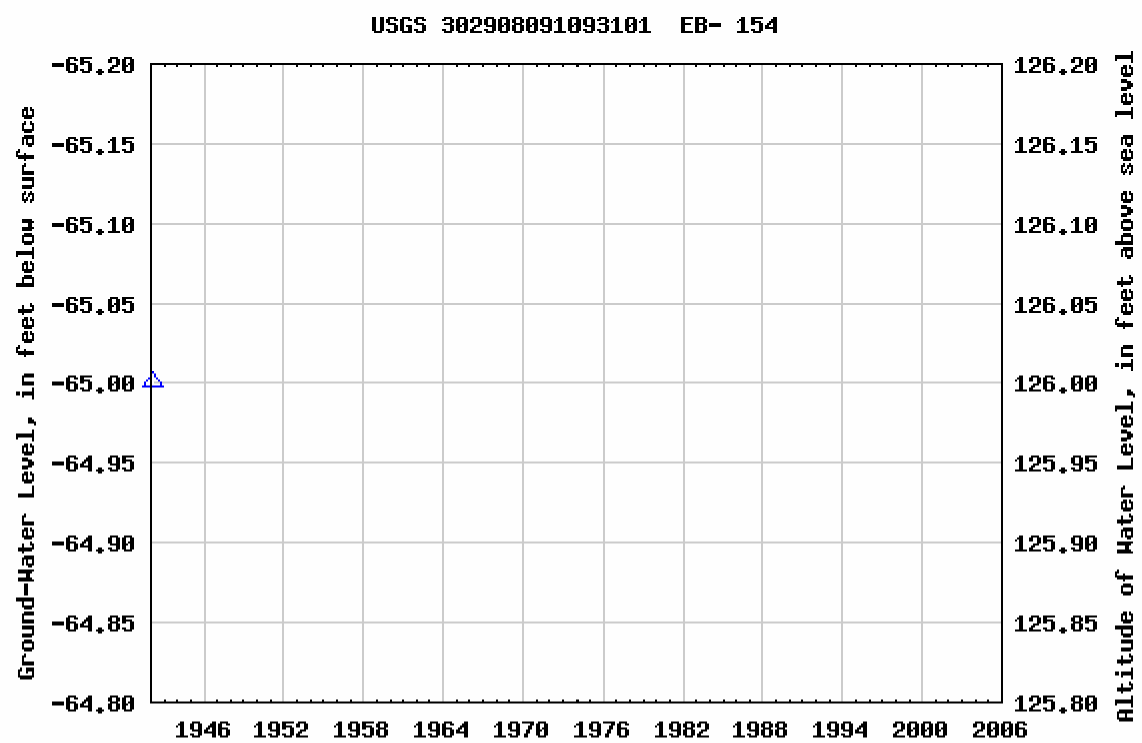
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-45.20
-45.15
-45.10
-45.05
-45.00
-44.95
-44.90
-44.85
-44.80
105.20
105.15
105.10
105.05
105.00
104.95
104.90
104.85
104.80
1928
1940
1952
1964
1976
1988
2000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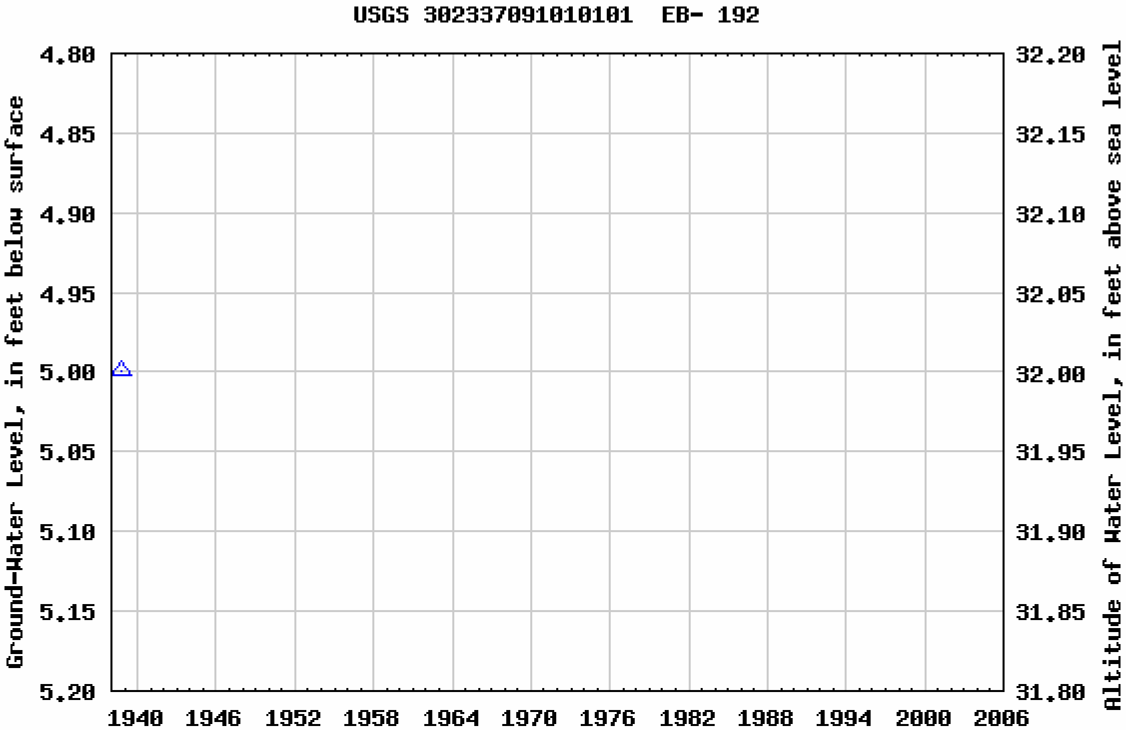
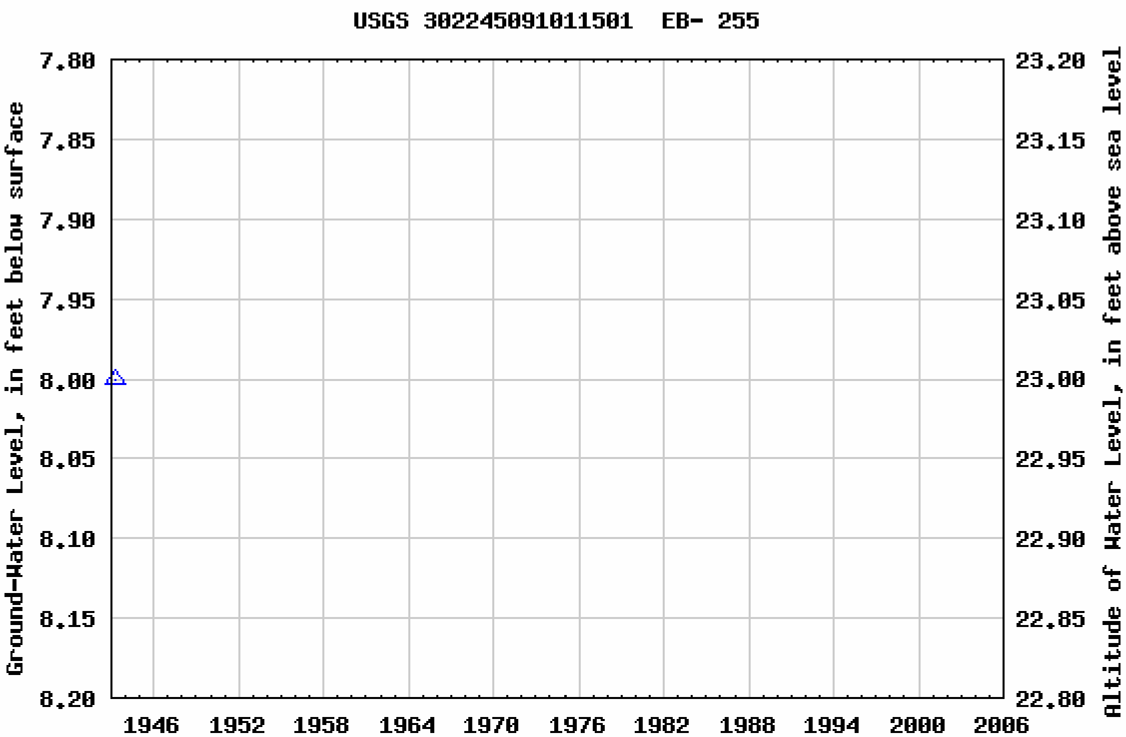
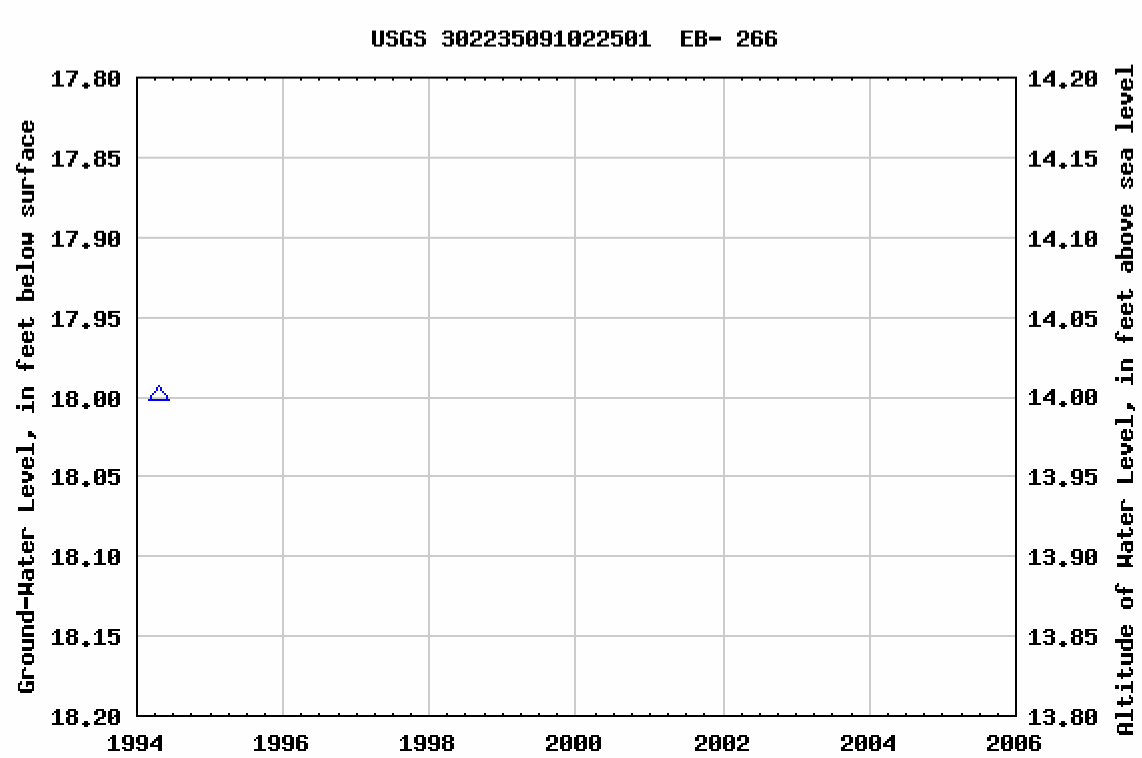
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-65.20
-65.15
-65.10
-65.05
-65.00
-64.95
-64.90
-64.85
-64.80
126.20
126.15
126.10
126.05
126.00
125.95
125.90
125.85
125.80
1946
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006


USGS 302337091010101 EB- 192
Ground-Water Level, in feet below surface
4.80
4.85
4.90
4.95
5.00
5.05
5.10
5.15
5.20
Altitude of Water Level, in feet above sea level
32.20
32.15
32.10
32.05
32.00
31.95
31.90
31.85
31.80
1940 1946 1952 1958 1964 1970 1976 1982 1988 1994 2000 2006


USGS 302245091011501 EB- 255
Ground-Water Level, in feet below surface
7.80
7.85
7.90
7.95
8.00
8.05
8.10
8.15
8.20
Altitude of Water Level, in feet above sea level
23.20
23.15
23.10
23.05
23.00
22.95
22.90
22.85
22.80
1946 1952 1958 1964 1970 1976 1982 1988 1994 2000 2006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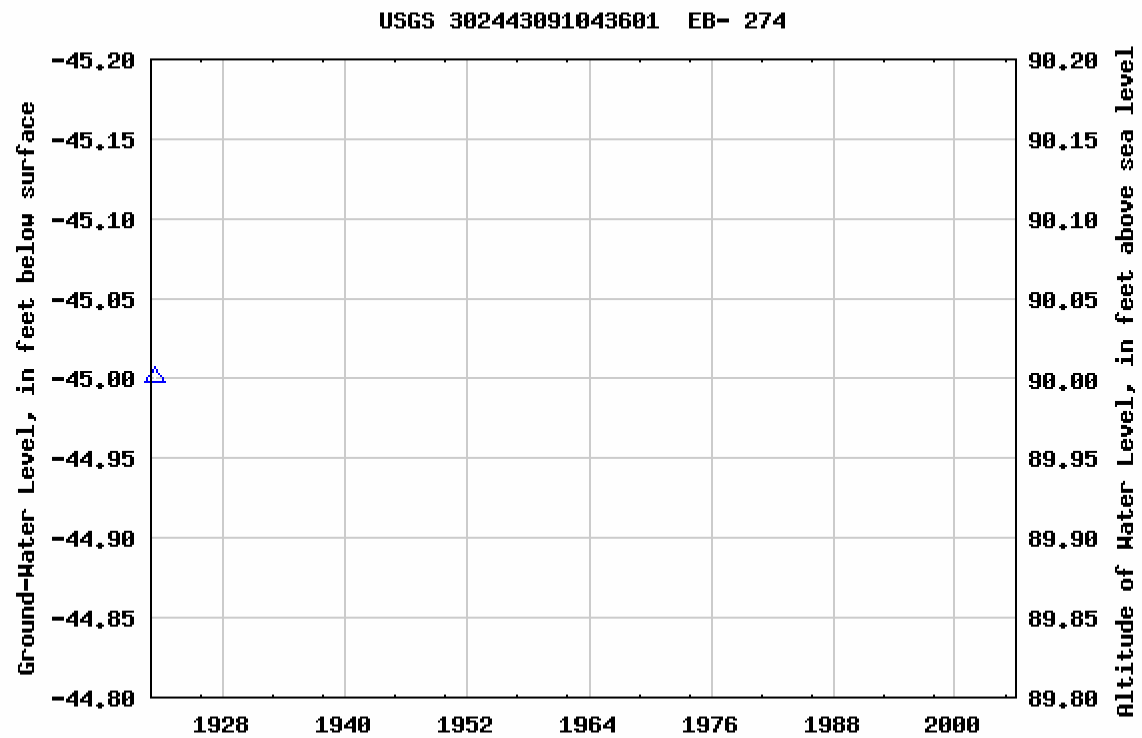
17.80
17.85
17.90
17.95
18.00
18.05
18.10
18.15
18.20
14.20
14.15
14.10
14.05
14.00
13.95
13.90
13.85
13.80
1994
1996
1998
2000
2002
2004
2006
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level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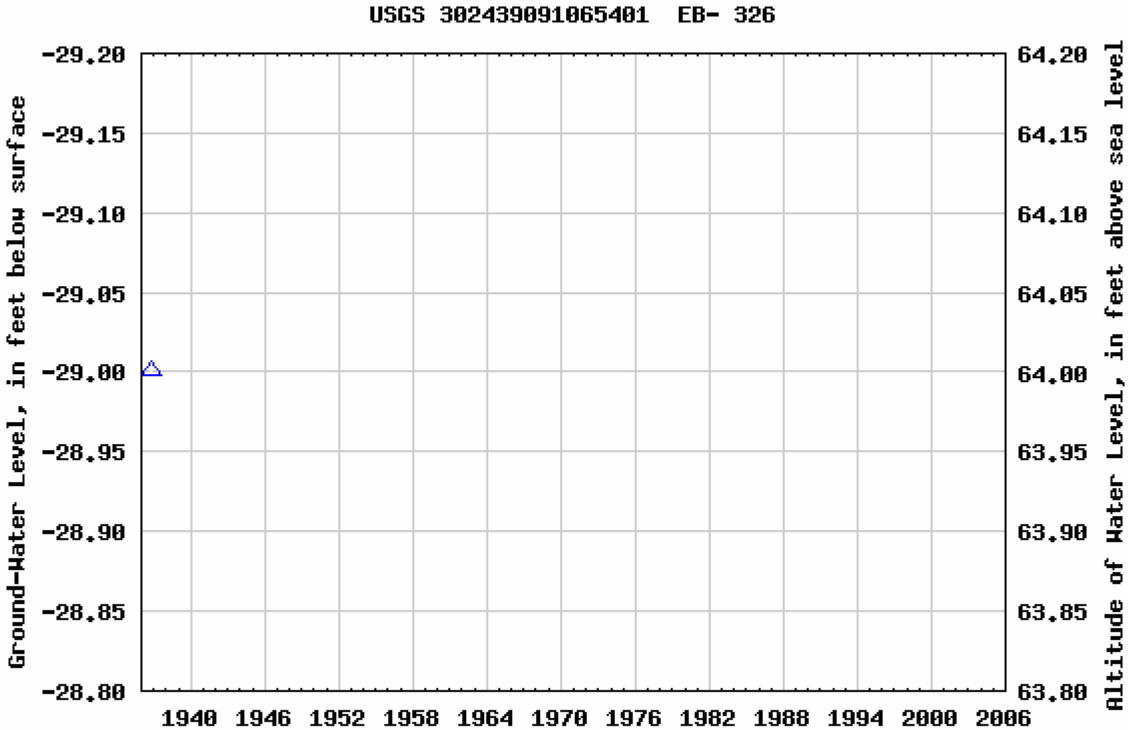
-45.15
-45.10
-45.05
-45.00
-44.95
-44.90
-44.85
-44.80
90.20
90.15
90.10
90.05
90.00
89.95
89.90
89.85
89.80
1928
1940
1952
1964
1976
1988
2000
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level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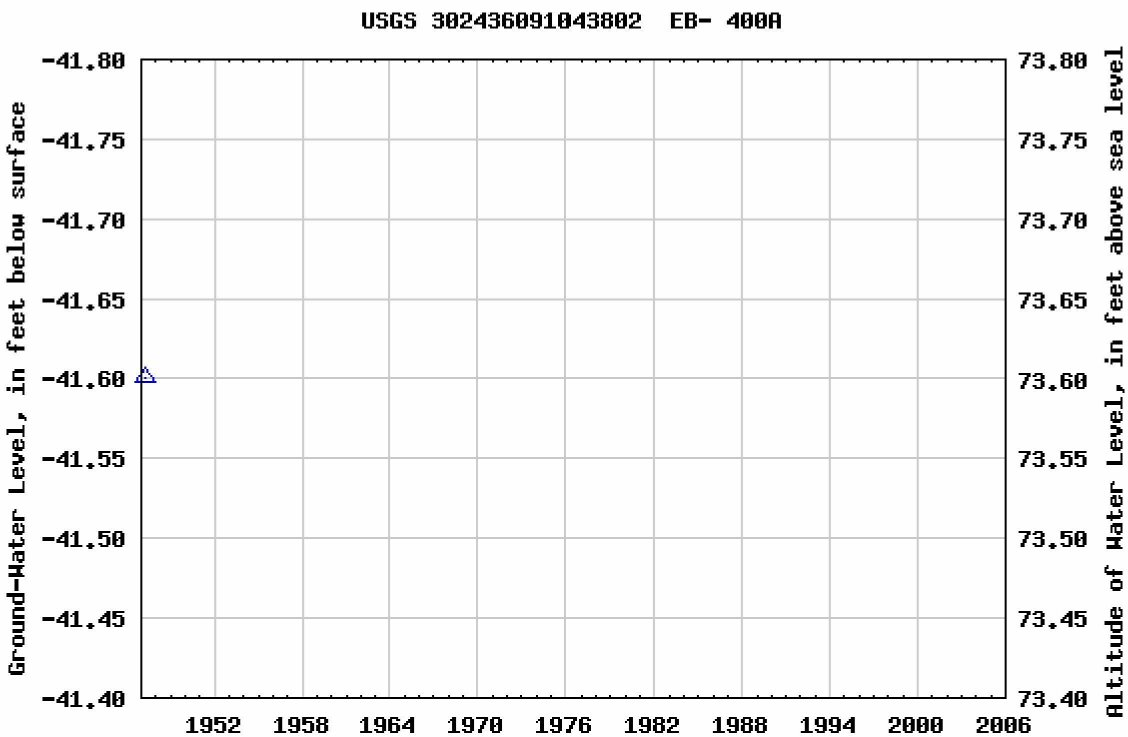
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-29.20
-29.15
-29.10
-29.05
-29.00
-28.95
-28.90
-28.85
-28.80
64.20
64.15
64.10
64.05
64.00
63.95
63.90
63.85
63.80
1940 1946 1952 1958 1964 1970 1976 1982 1988 1994 2000 2006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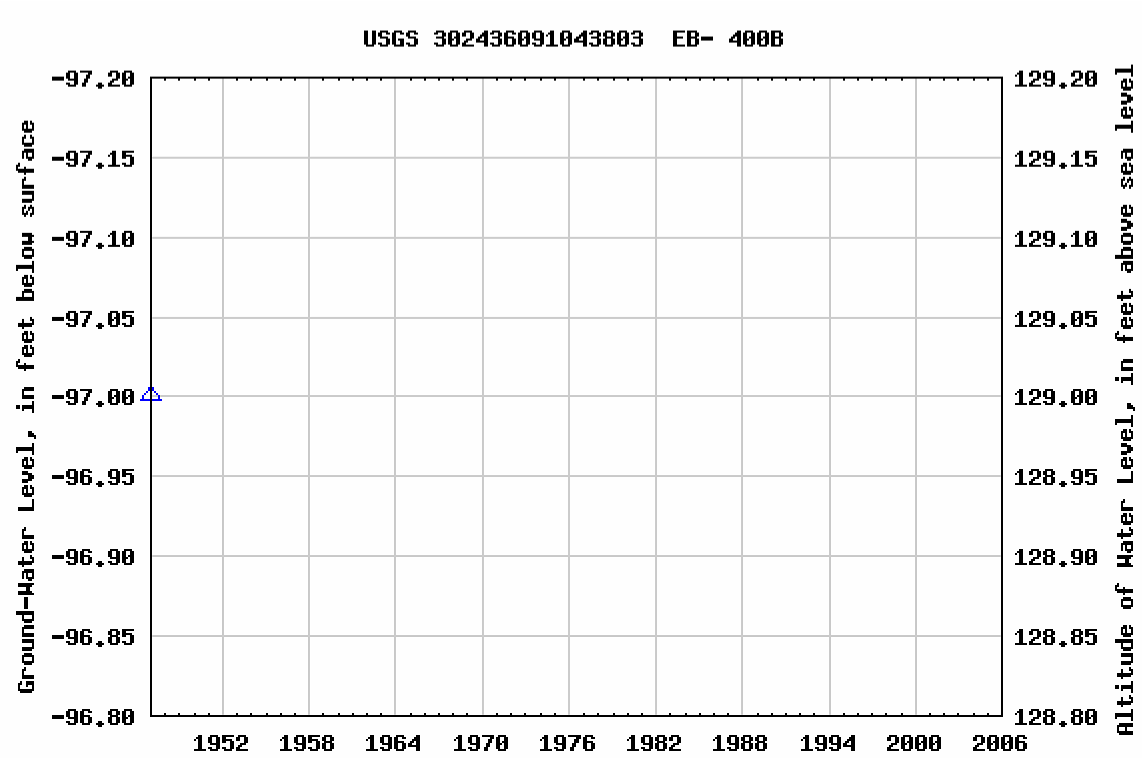
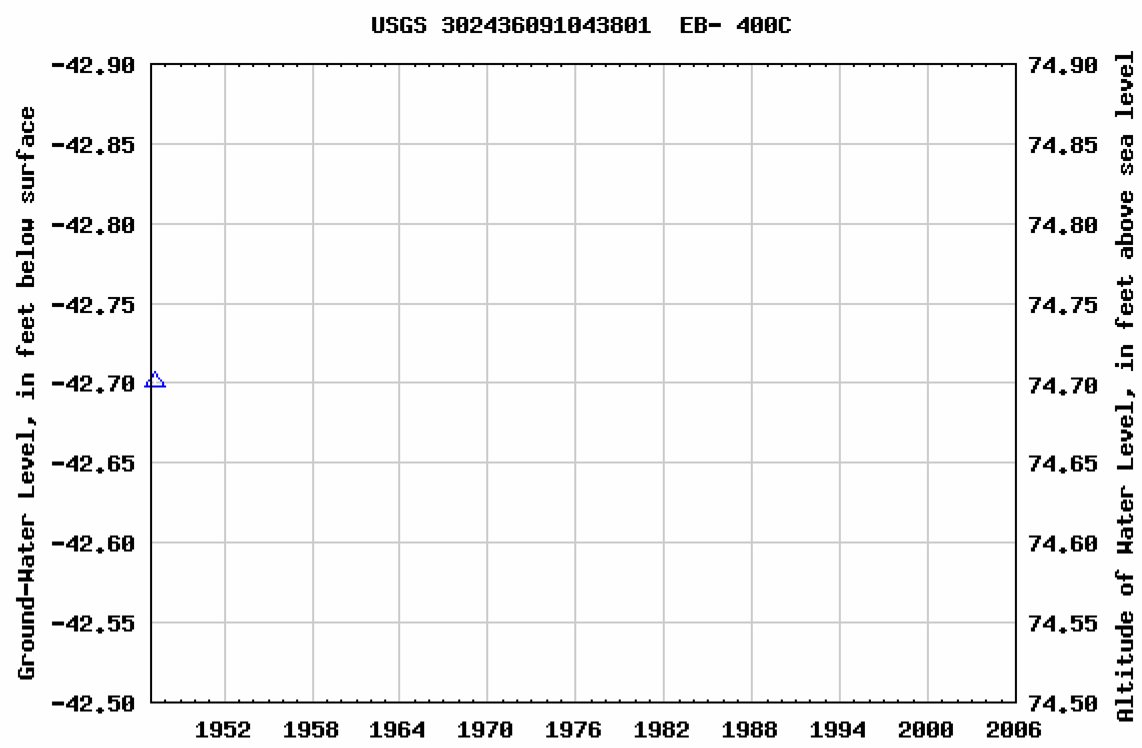
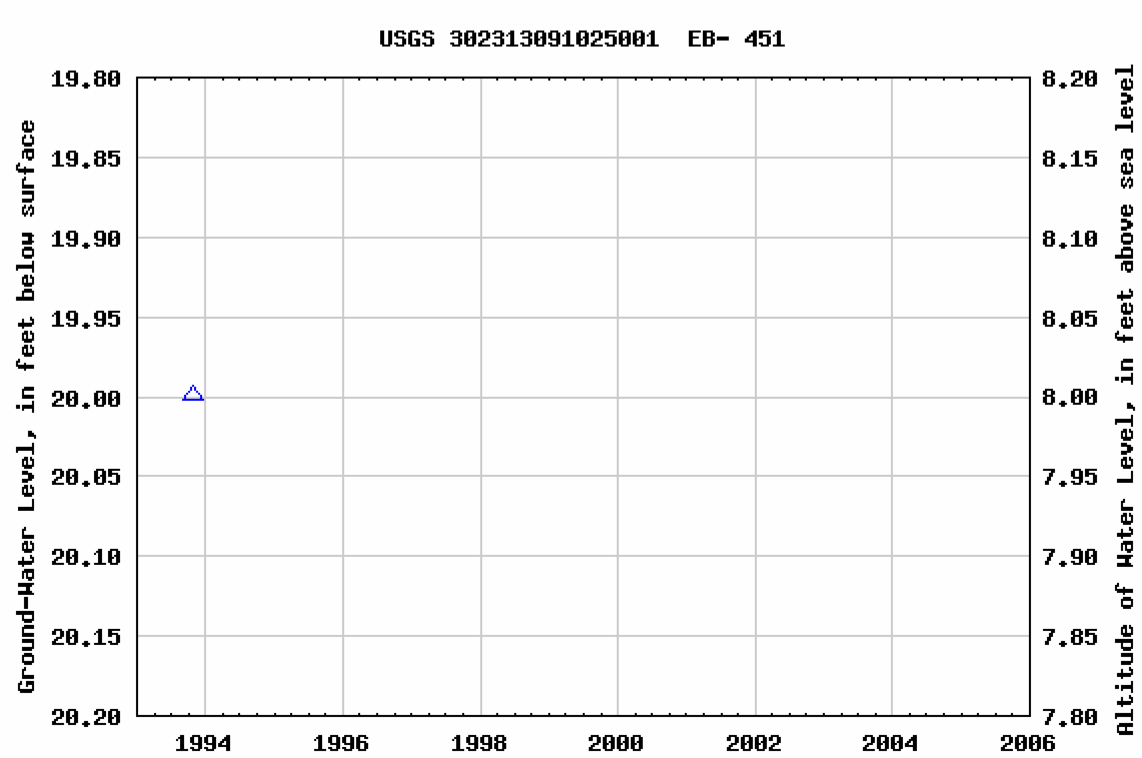
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-41.80
-41.75
-41.70
-41.65
-41.60
-41.55
-41.50
-41.45
-41.40
73.80
73.75
73.70
73.65
73.60
73.55
73.50
73.45
73.40
1952 1958 1964 1970 1976 1982 1988 1994 2000 2006

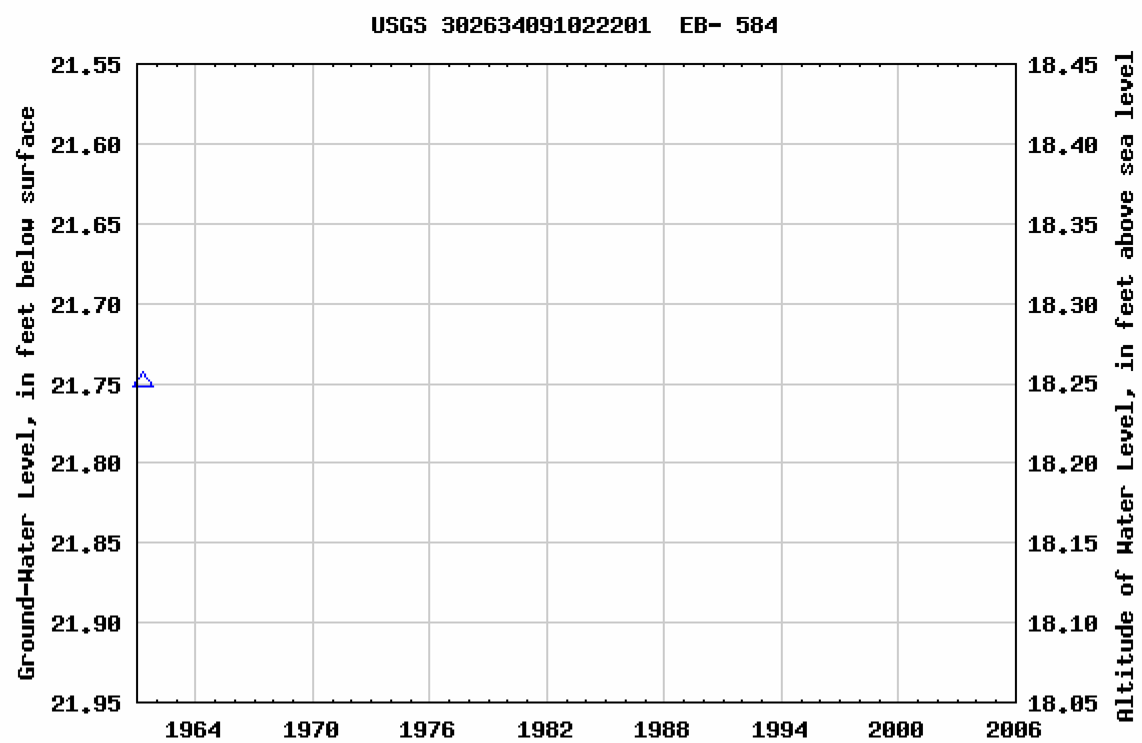


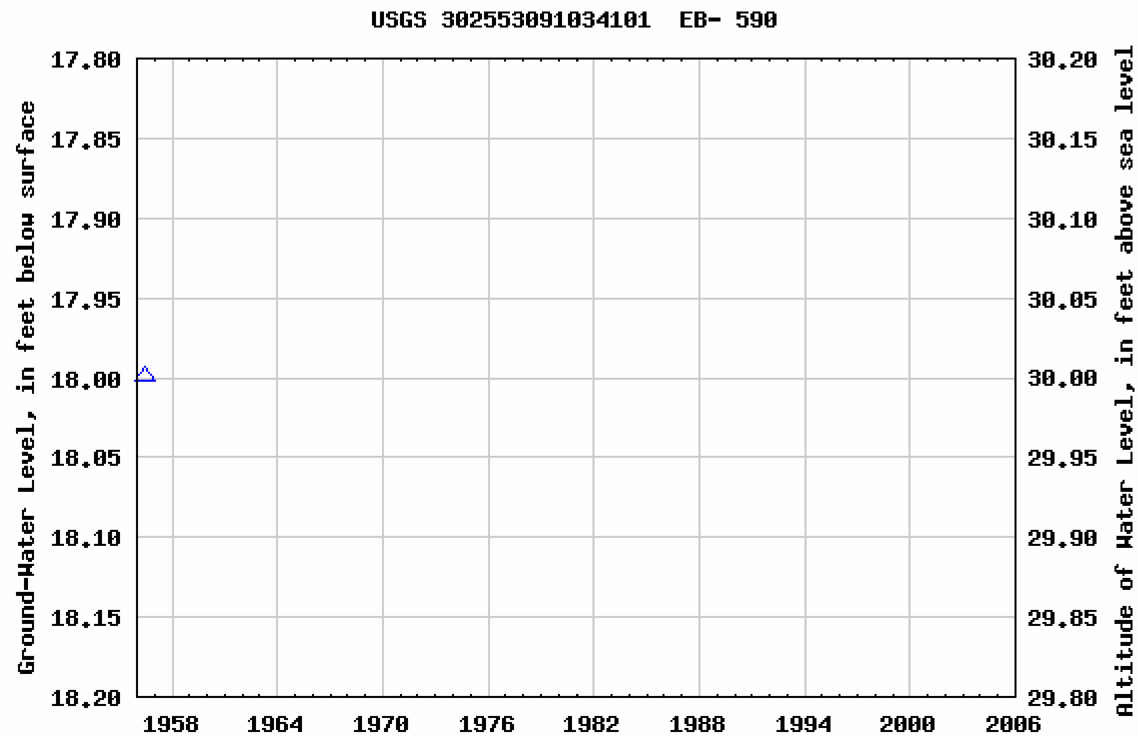
USGS 302436091043803 EB- 400B
-97.20
-97.15
-97.10
-97.05
-97.00
-96.95
-96.90
-96.85
-96.80
129.20
129.15
129.10
129.05
129.00
128.95
128.90
128.85
128.80
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level

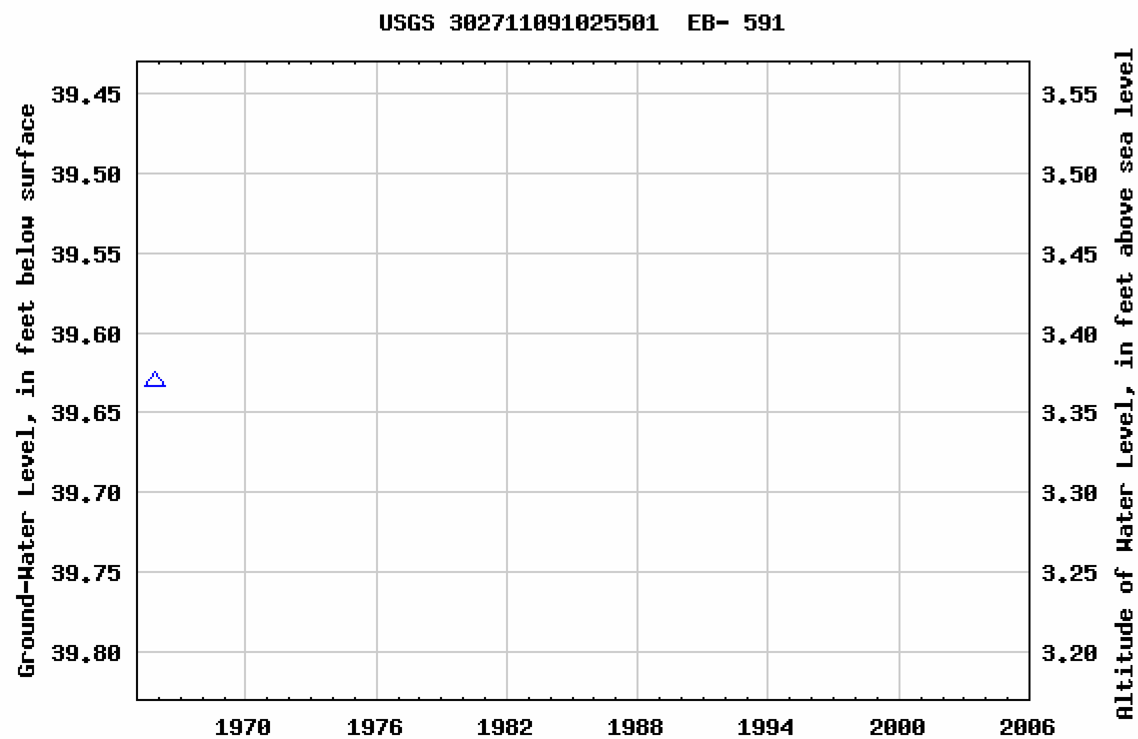


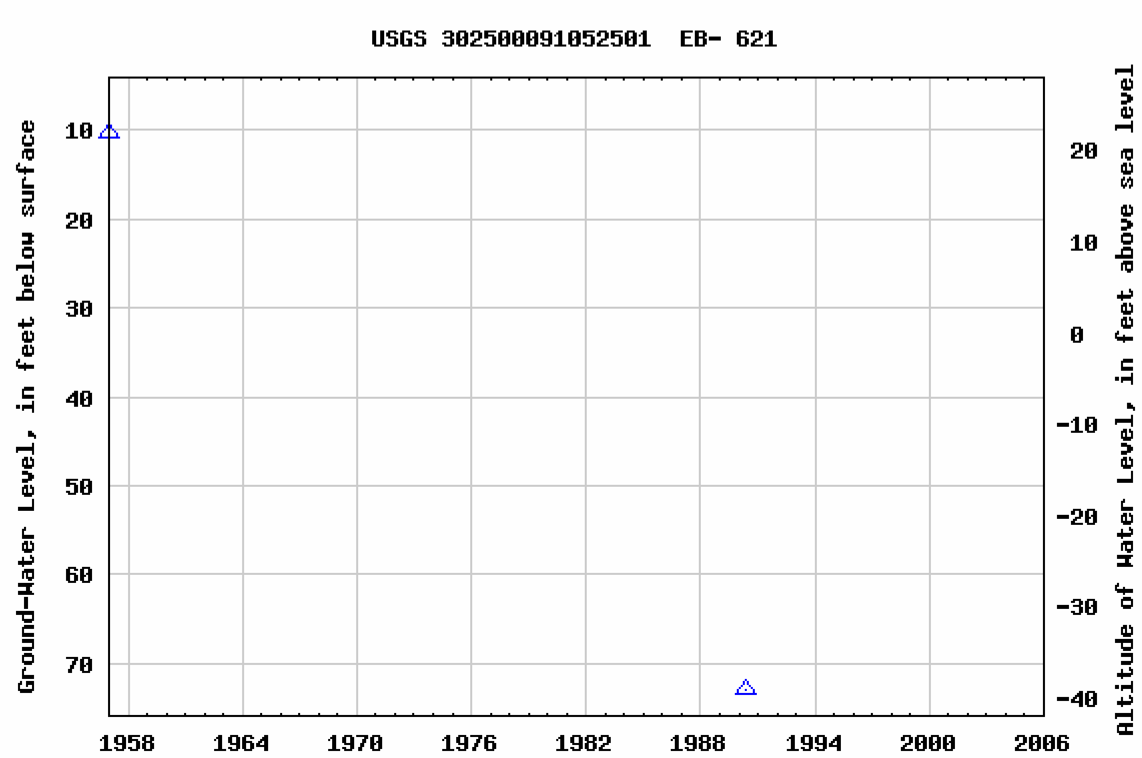
USGS 302436091043801 EB- 400C
-42.90
-42.85
-42.80
-42.75
-42.70
-42.65
-42.60
-42.55
-42.50
74.90
74.85
74.80
74.75
74.70
74.65
74.60
74.55
74.50
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level


USGS 302313091025001 EB- 451
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
19.80
19.85
19.90
19.95
20.00
20.05
20.10
20.15
20.20
8.20
8.15
8.10
8.05
8.00
7.95
7.90
7.85
7.80
1994
1996
1998
2000
2002
2004
2006

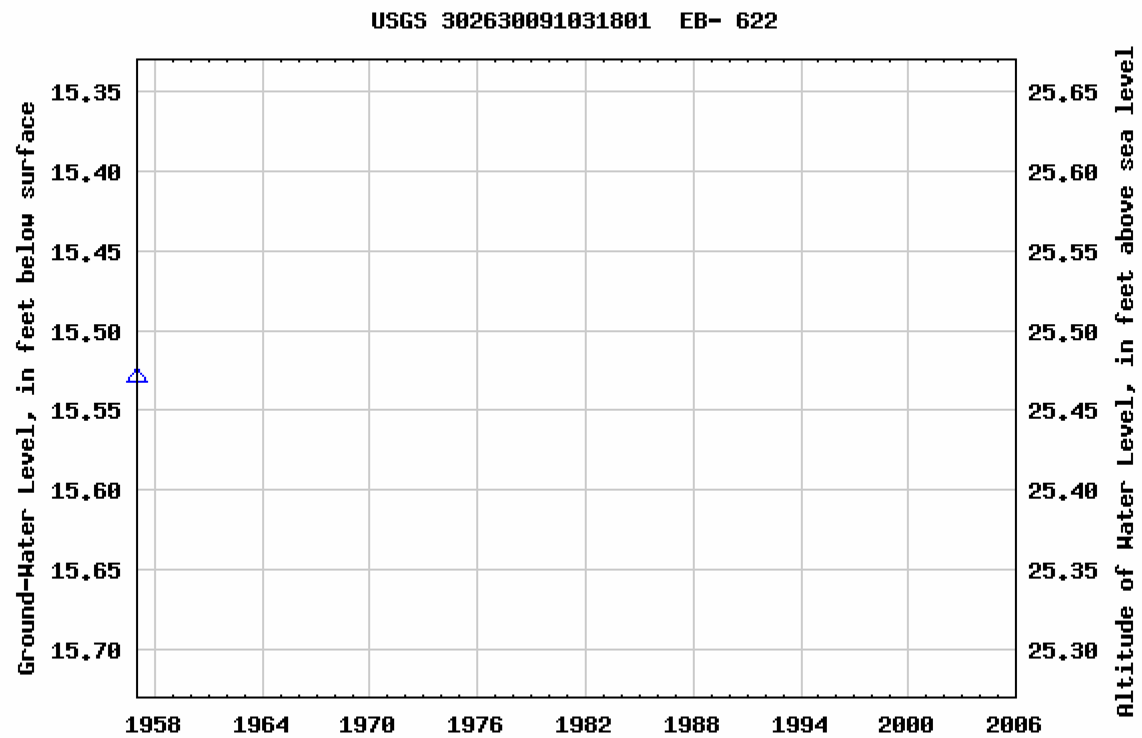

USGS 302634091022201 EB- 584
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
21.55
21.60
21.65
21.70
21.75
21.80
21.85
21.90
21.95
18.45
18.40
18.35
18.30
18.25
18.20
18.15
18.10
18.05
1964
1970
1976
1982
1988
1994
2000
2006


USGS 302553091034101 EB- 590
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
17.80
17.85
17.90
17.95
18.00
18.05
18.10
18.15
18.20
30.20
30.15
30.10
30.05
30.00
29.95
29.90
29.85
29.80
1958 1964 1970 1976 1982 1988 1994 2000 2006

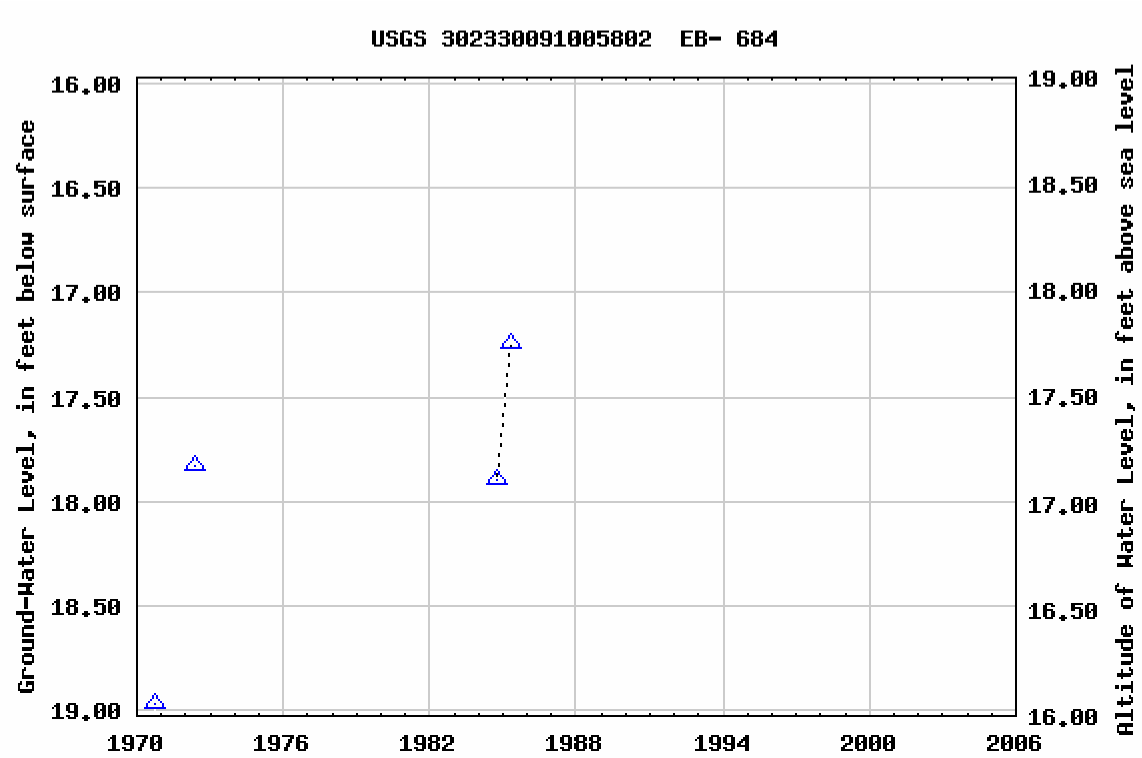

USGS 302711091025501 EB- 591
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
39.45
39.50
39.55
39.60
39.65
39.70
39.75
39.80
3.55
3.50
3.45
3.40
3.35
3.30
3.25
3.20
1970 1976 1982 1988 1994 2000 2006

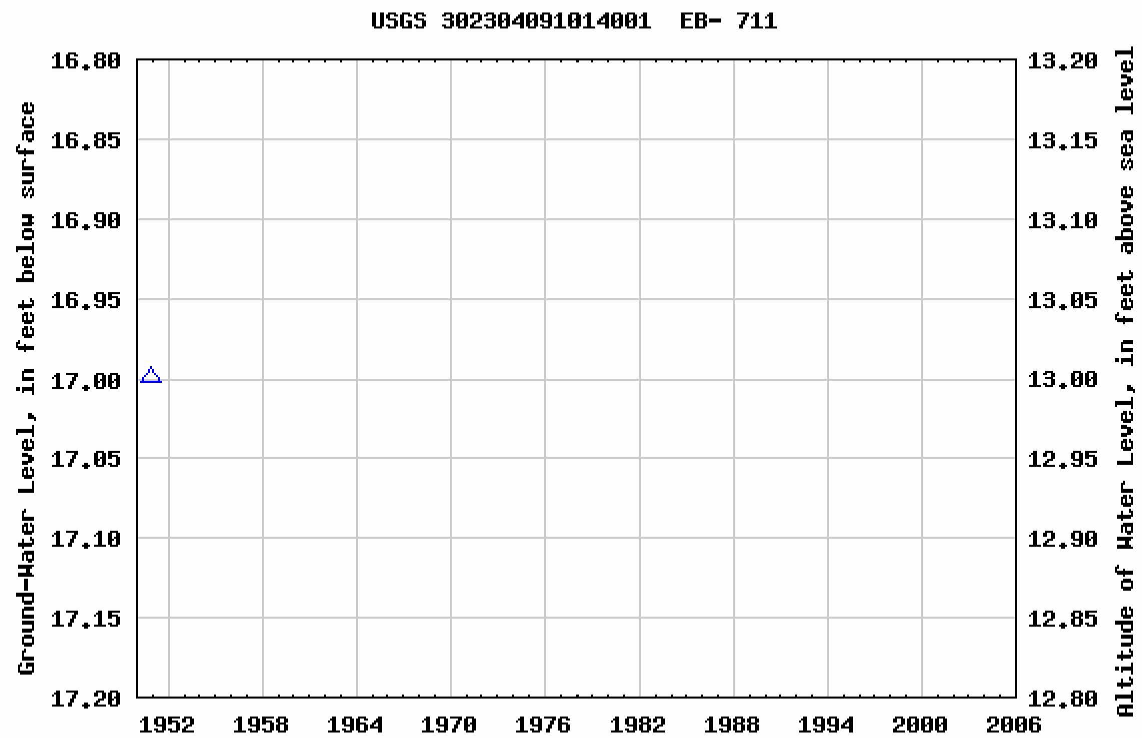


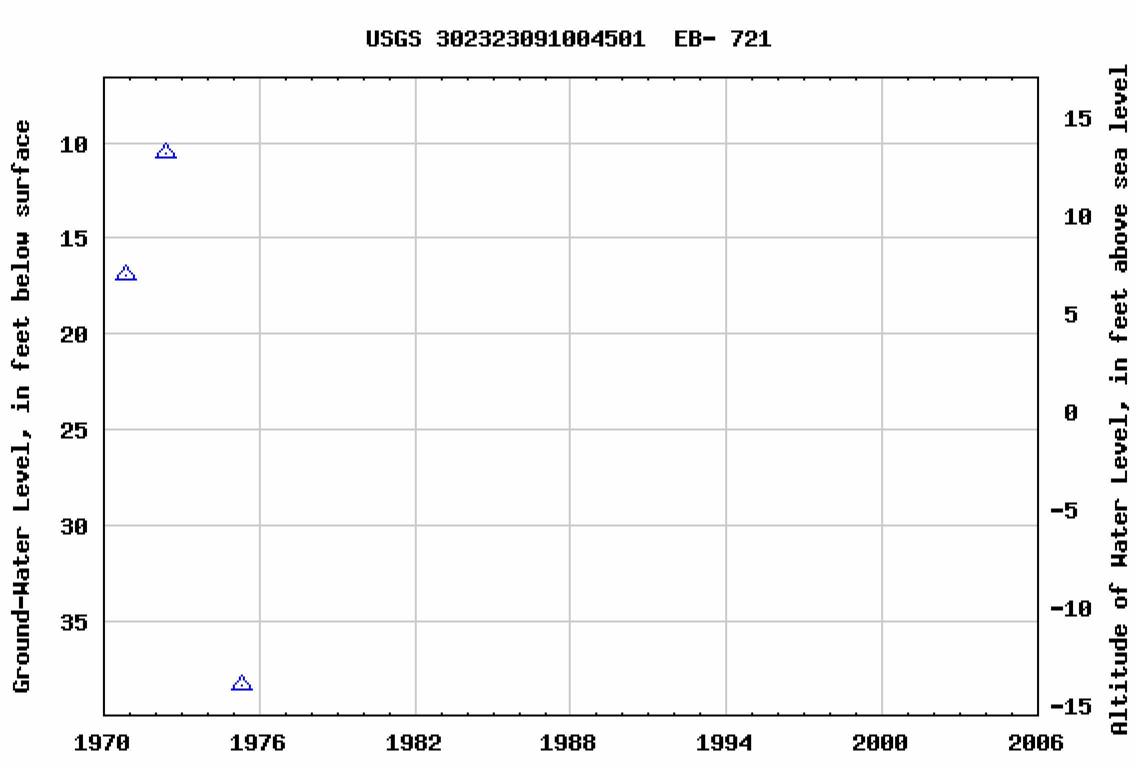
USGS 302500091052501 EB- 621
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
10
20
30
40
50
60
70
20
10
0
-10
-20
-30
-40
1958
1964
1970
1976
1982
1988
1994
2000
2006

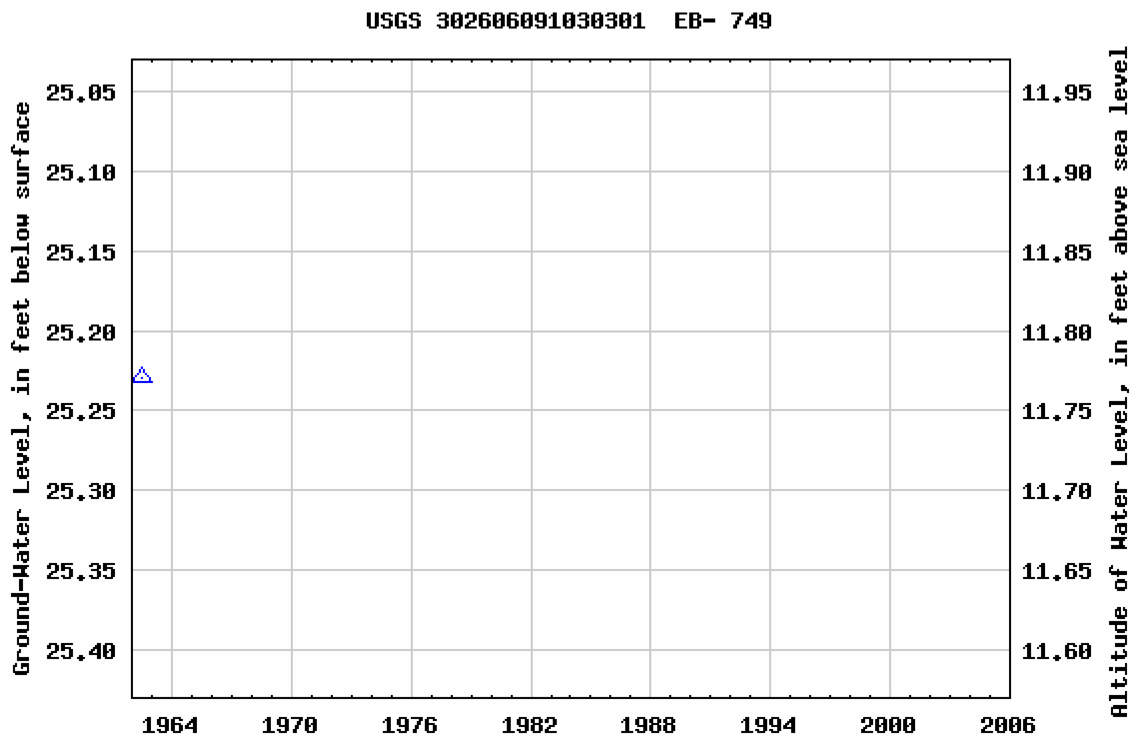


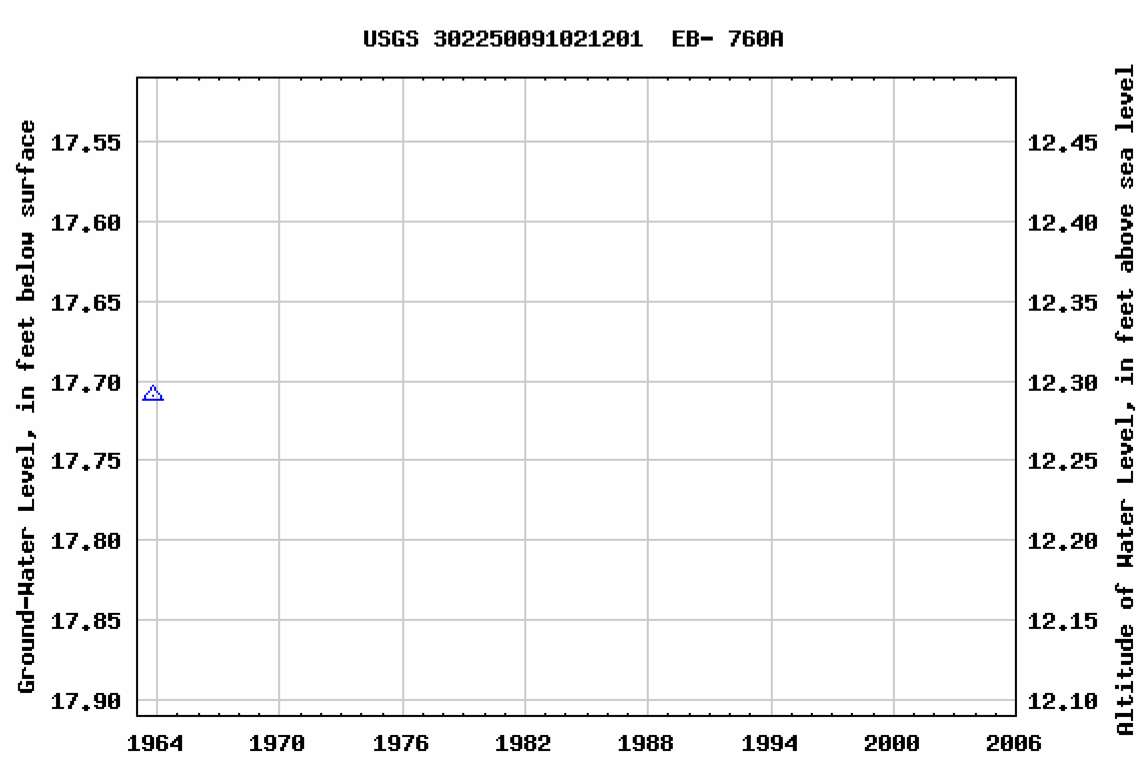
USGS 302630091031801 EB- 622
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
15.35
15.40
15.45
15.50
15.55
15.60
15.65
15.70
25.65
25.60
25.55
25.50
25.45
25.40
25.35
25.30
1958
1964
1970
1976
1982
1988
1994
2000
2006

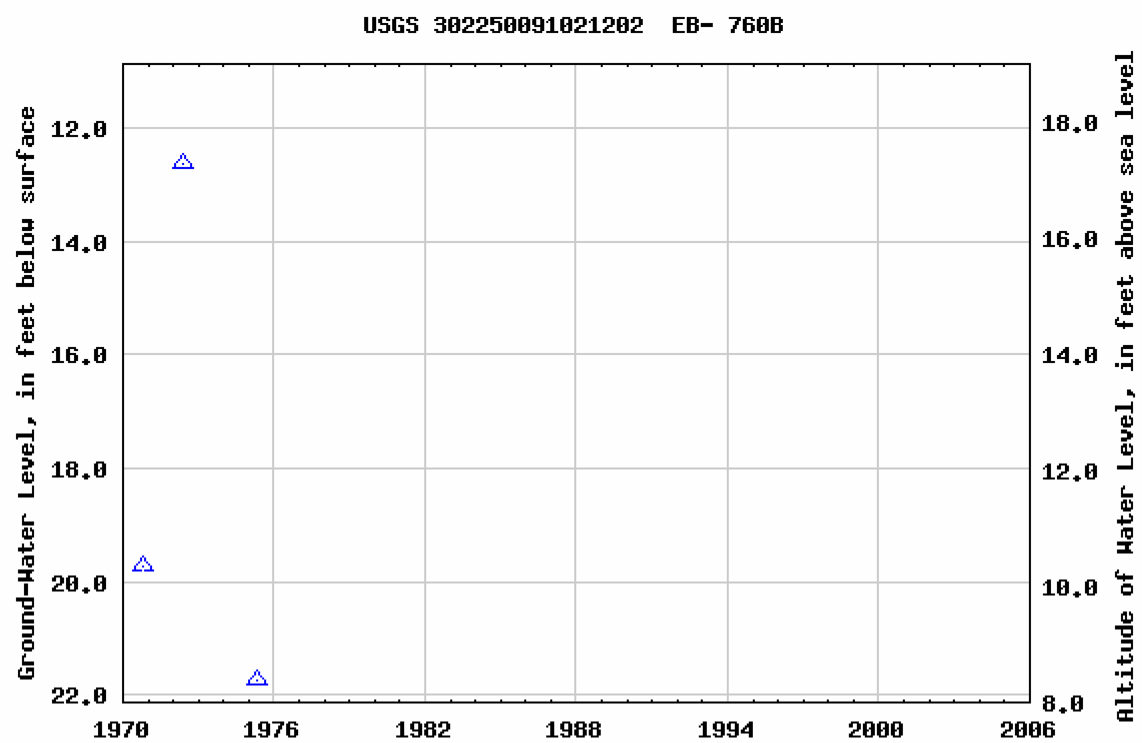

USGS 302330091005802 EB- 684
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
16.00
16.50
17.00
17.50
18.00
18.50
19.00
19.00
18.50
18.00
17.50
17.00
16.50
16.00
1970
1976
1982
1988
1994
2000
2006

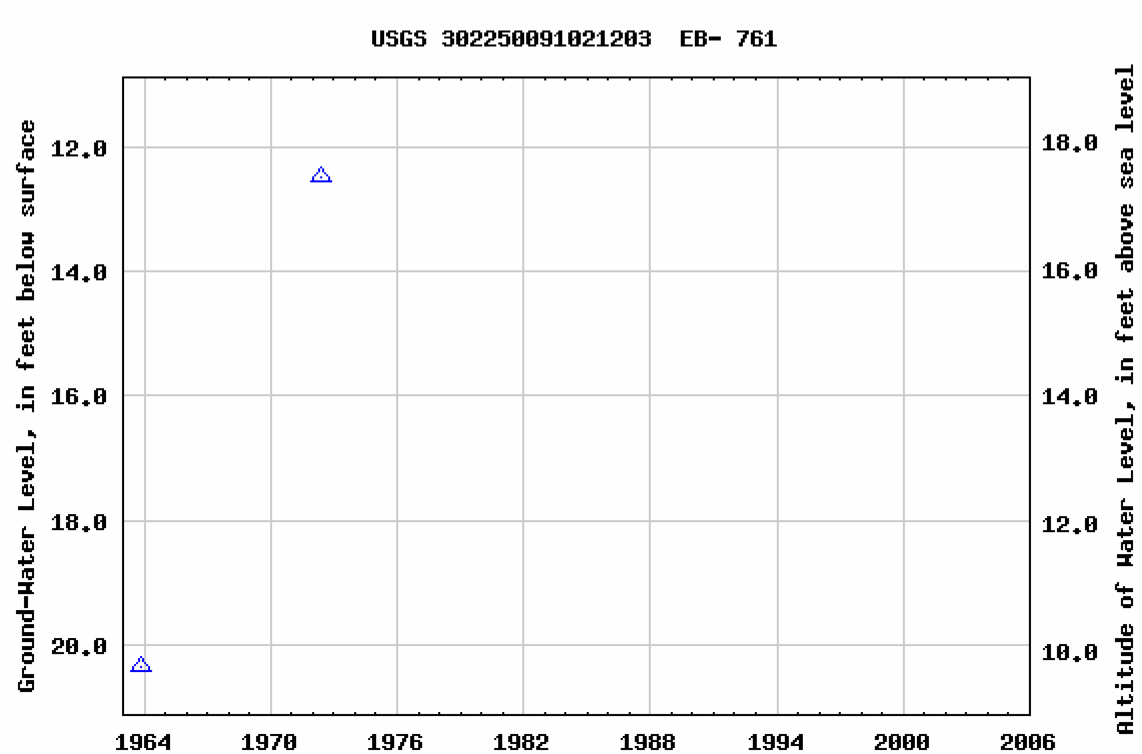

USGS 302304091014001 EB- 711
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
16.80
16.85
16.90
16.95
17.00
17.05
17.10
17.15
17.20
13.20
13.15
13.10
13.05
13.00
12.95
12.90
12.85
12.80
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006

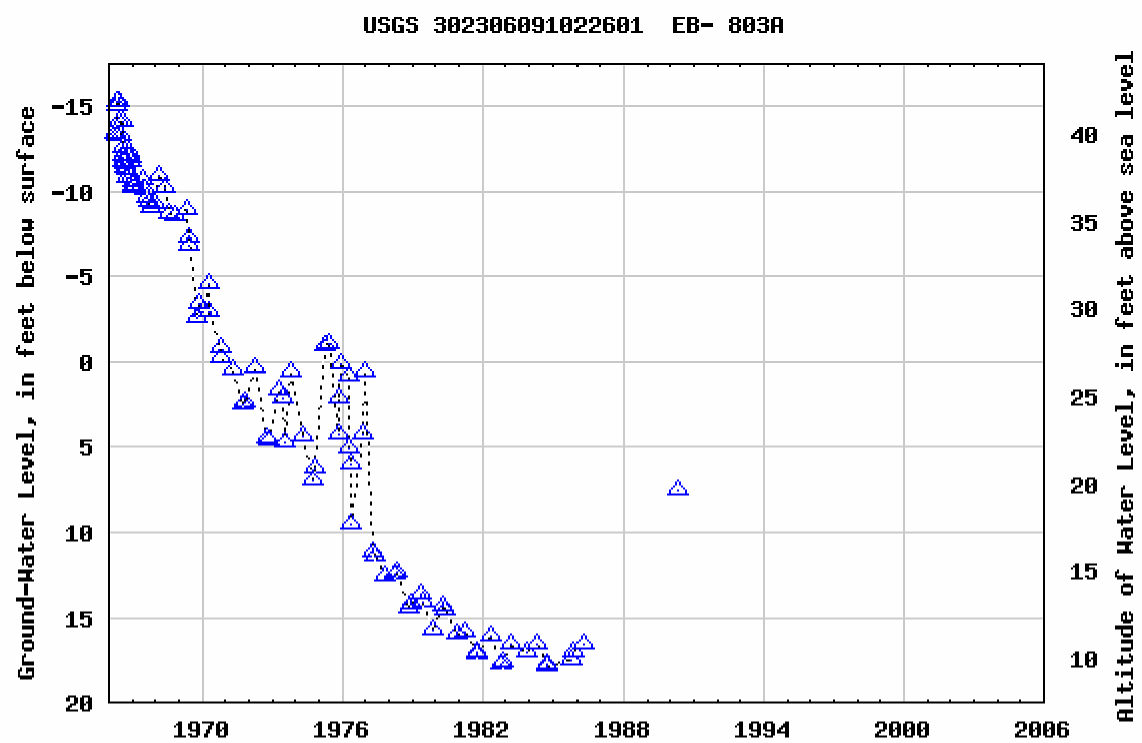

USGS 302323091004501 EB- 721
Ground-Water Level, in feet below surface
10
15
20
25
30
35
Altitude of Water Level, in feet above sea level
15
10
5
0
-5
-10
-15
1970
1976
1982
1988
1994
2000
2006

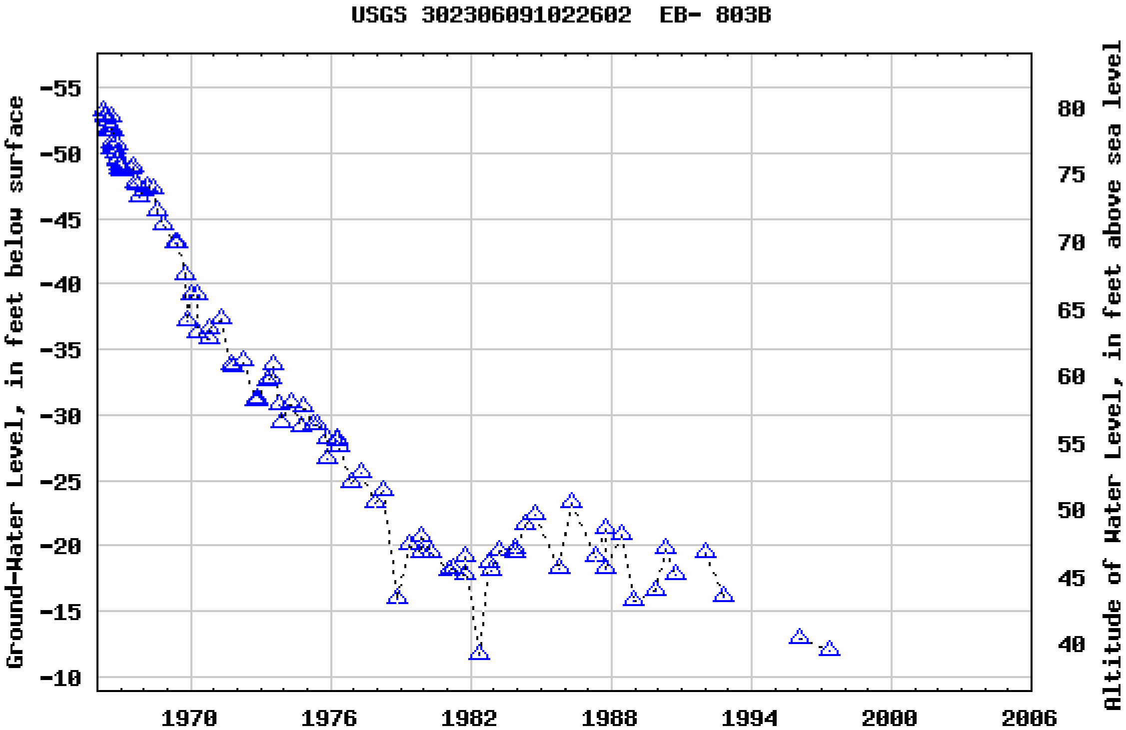

USGS 302606091030301 EB- 749
Ground-Water Level, in feet below surface
25.05
25.10
25.15
25.20
25.25
25.30
25.35
25.40
Altitude of Water Level, in feet above sea level
11.95
11.90
11.85
11.80
11.75
11.70
11.65
11.60
1964
1970
1976
1982
1988
1994
2000
2006


USGS 302250091021201 EB- 760A
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
17.55
17.60
17.65
17.70
17.75
17.80
17.85
17.90
12.45
12.40
12.35
12.30
12.25
12.20
12.15
12.10
1964
1970
1976
1982
1988
1994
2000
2006

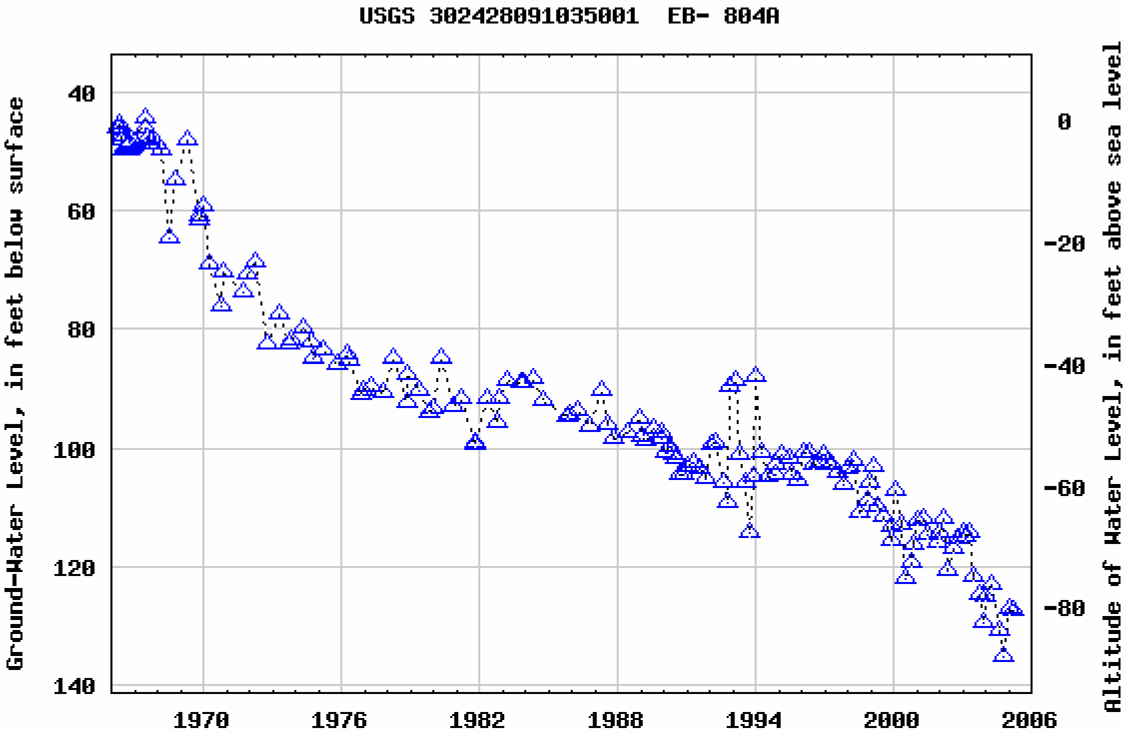

USGS 302250091021202 EB- 760B
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
12.0
14.0
16.0
18.0
20.0
22.0
18.0
16.0
14.0
12.0
10.0
8.0
1970
1976
1982
1988
1994
2000
2006


USGS 302250091021203 EB- 761
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
12.0
14.0
16.0
18.0
20.0
18.0
16.0
14.0
12.0
10.0
1964
1970
1976
1982
1988
1994
2000
2006

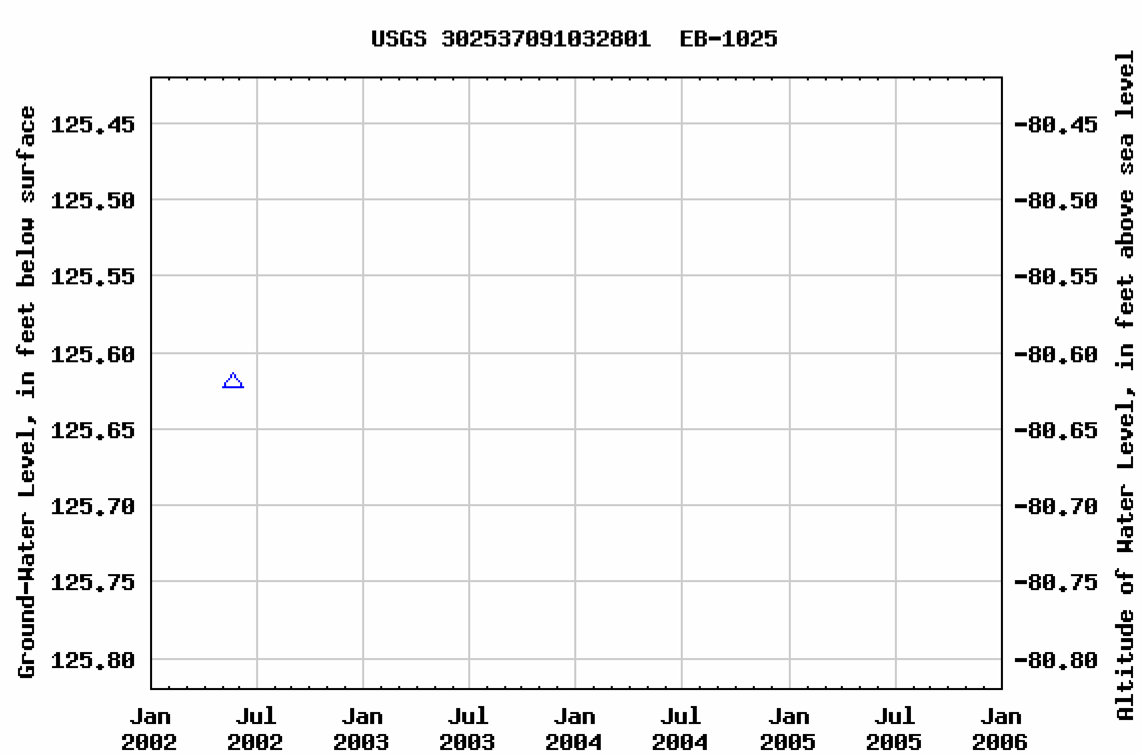

USGS 302306091022601 EB- 803A
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-15
-10
-5
0
5
10
15
20
40
35
30
25
20
15
10
1970
1976
1982
1988
1994
2000
2006



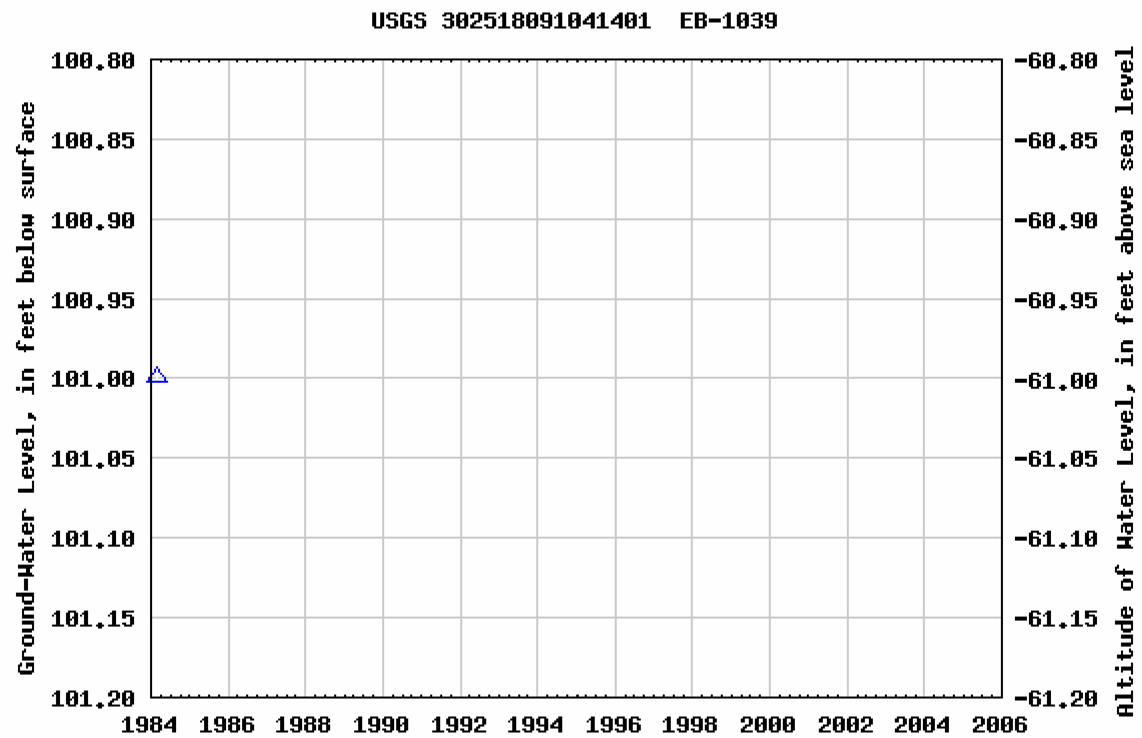
USGS 302306091022602 EB- 803B
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-55
-50
-45
-40
-35
-30
-25
-20
-15
-10
80
75
70
65
60
55
50
45
40
1970
1976
1982
1988
1994
2000
2006



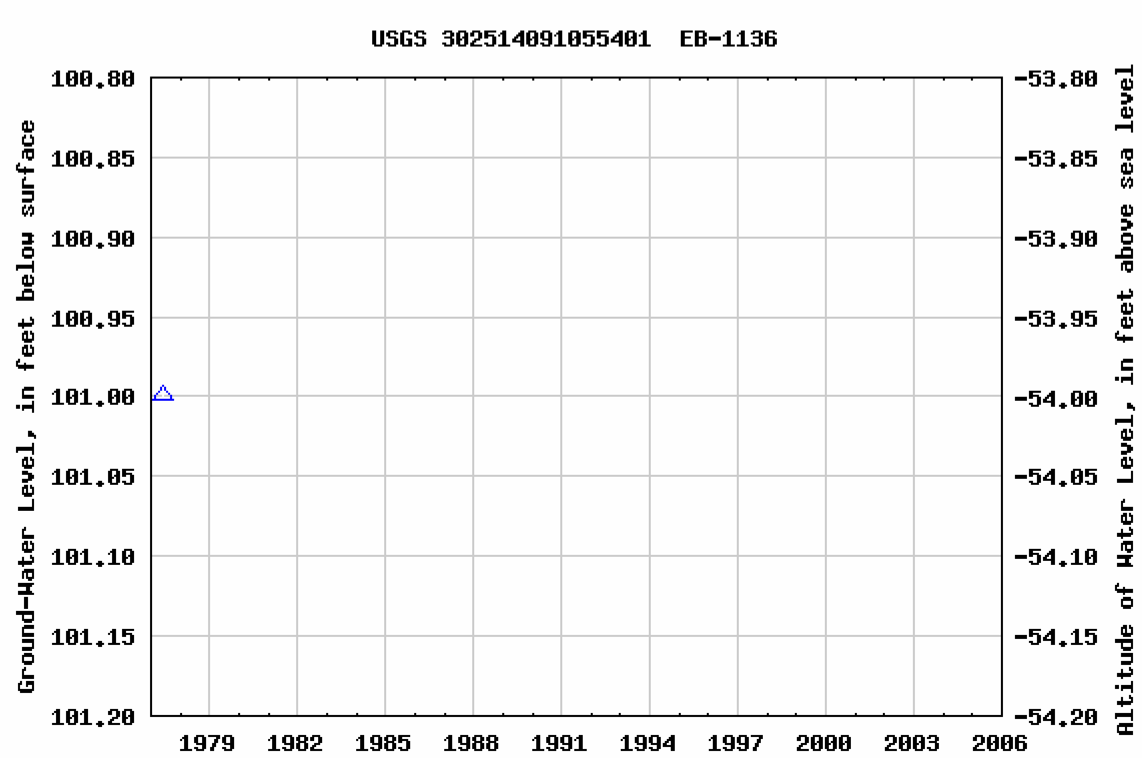
USGS 302428091035001 EB- 804A
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
40
60
80
100
120
140
0
-20
-40
-60
-80
1970
1976
1982
1988
1994
2000
2006

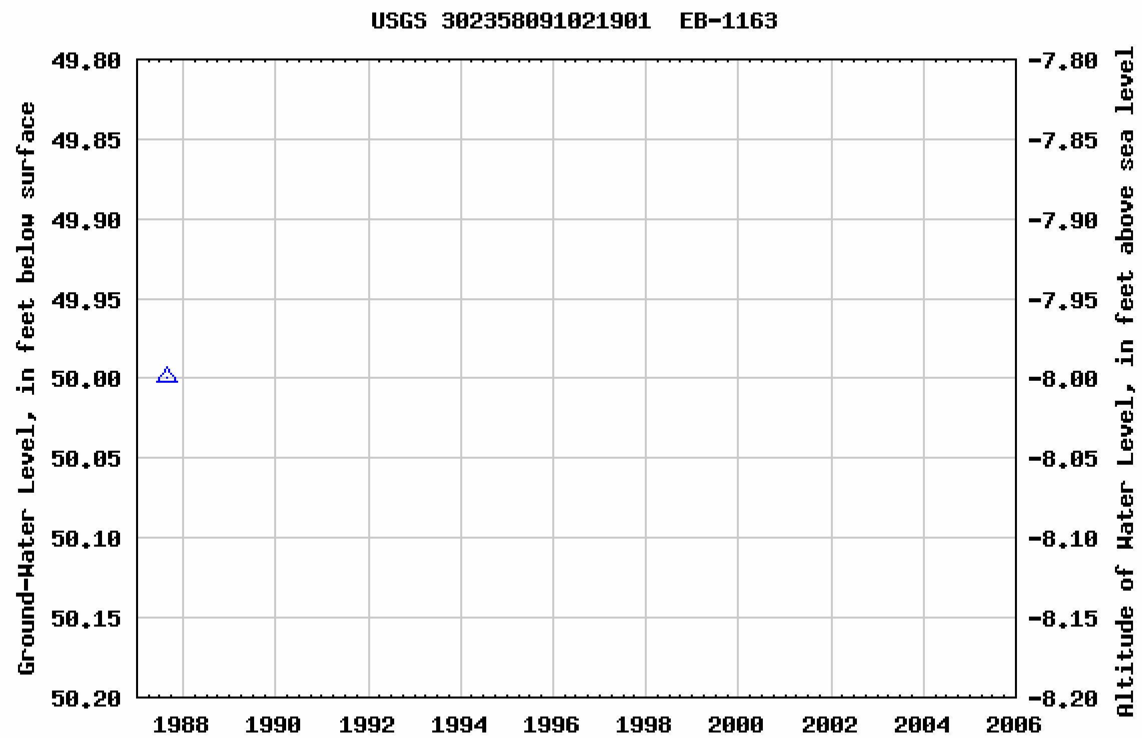


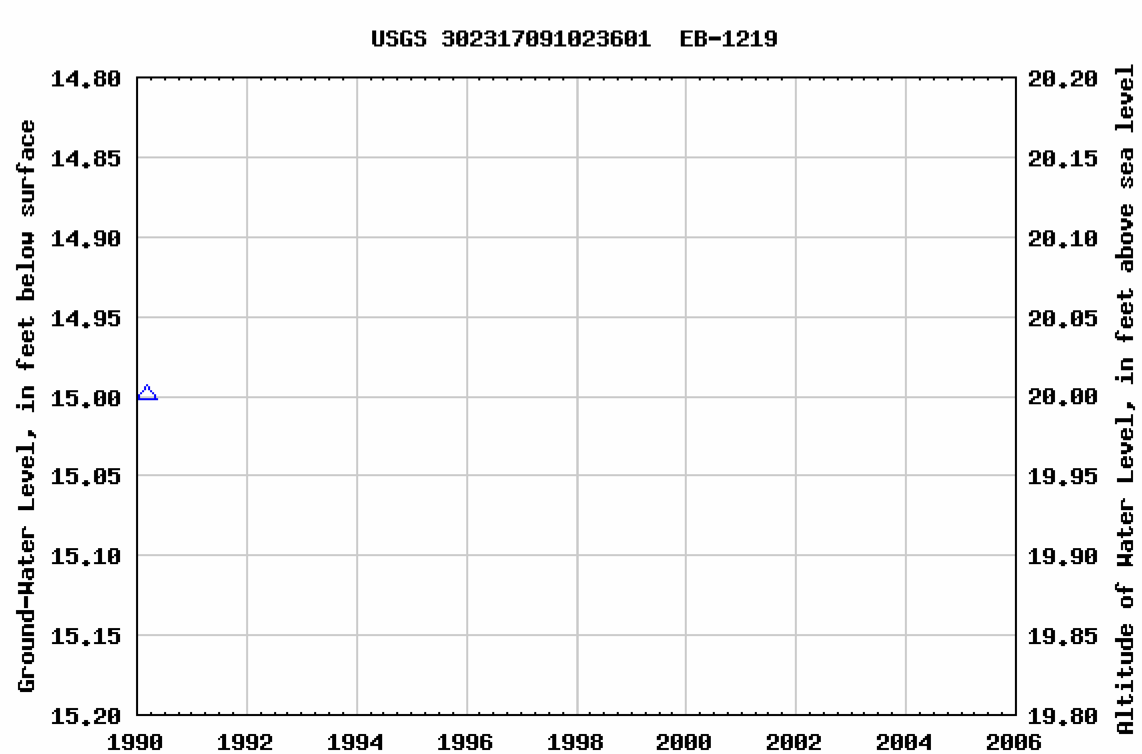
USGS 302537091032801 EB-1025
Ground-Water Level, in feet below surface
125.45
125.50
125.55
125.60
125.65
125.70
125.75
125.80
Altitude of Water Level, in feet above sea level
-80.45
-80.50
-80.55
-80.60
-80.65
-80.70
-80.75
-80.80
Jan 2002
Jul 2002
Jan 2003
Jul 2003
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006

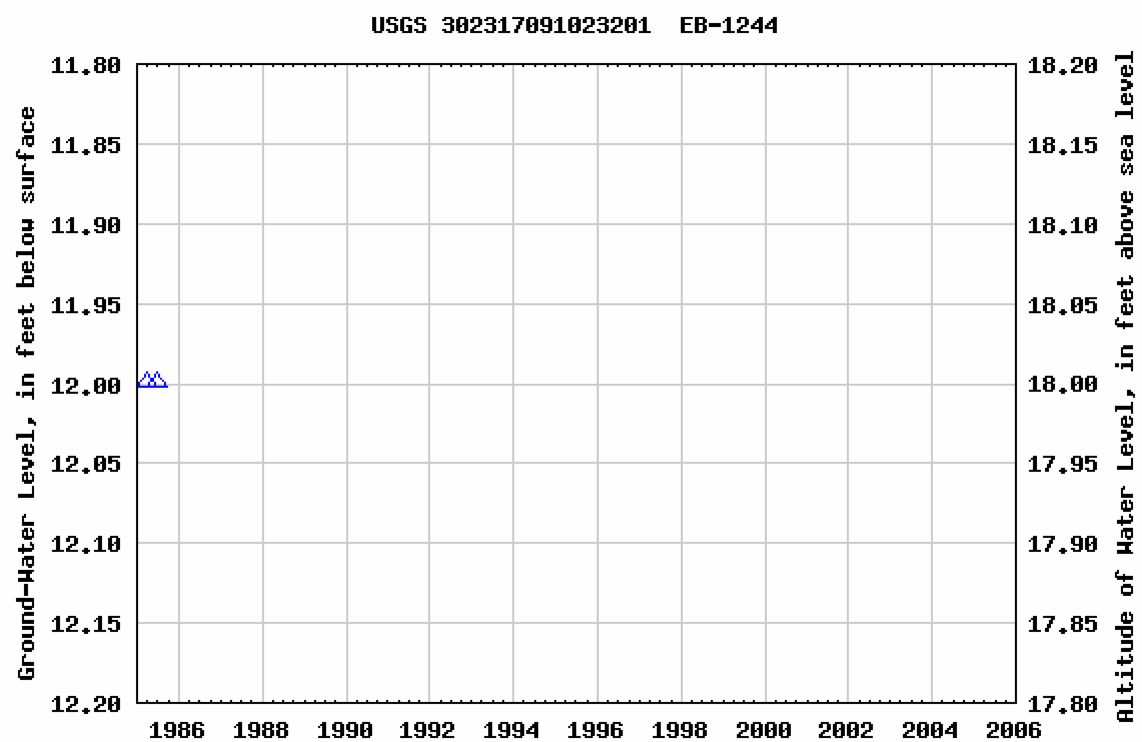


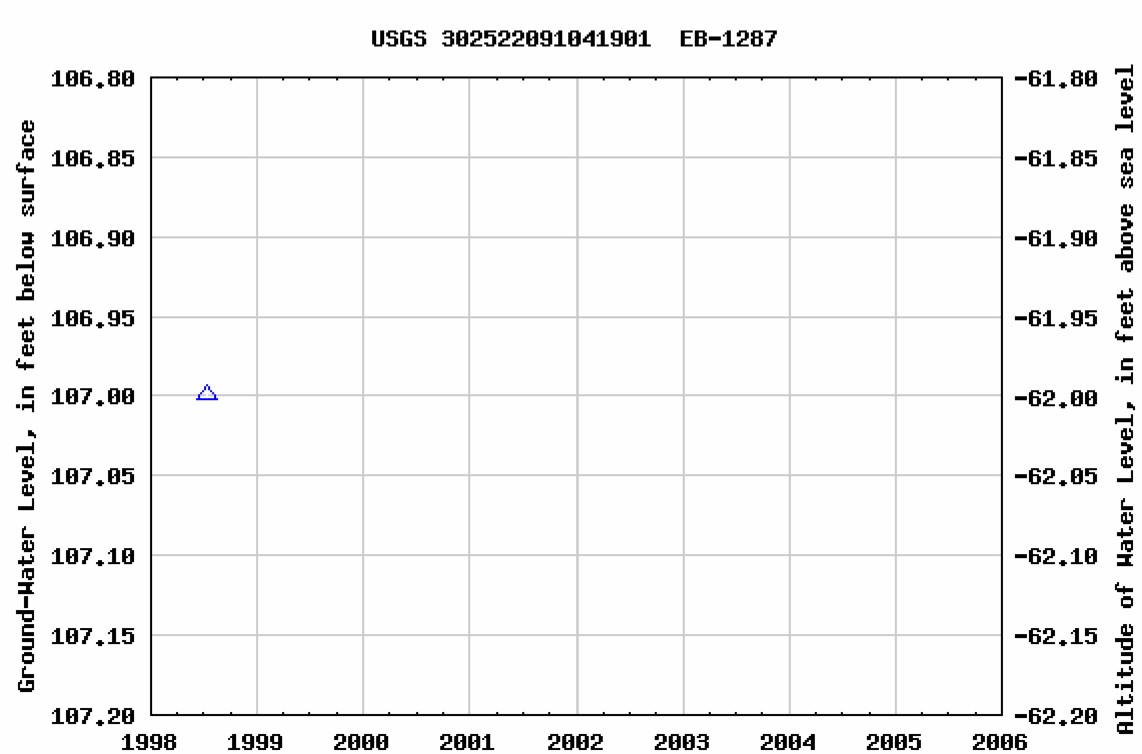
USGS 302518091041401 EB-1039
Ground-Water Level, in feet below surface
100.80
100.85
100.90
100.95
101.00
101.05
101.10
101.15
101.20
Altitude of Water Level, in feet above sea level
-60.80
-60.85
-60.90
-60.95
-61.00
-61.05
-61.10
-61.15
-61.20
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

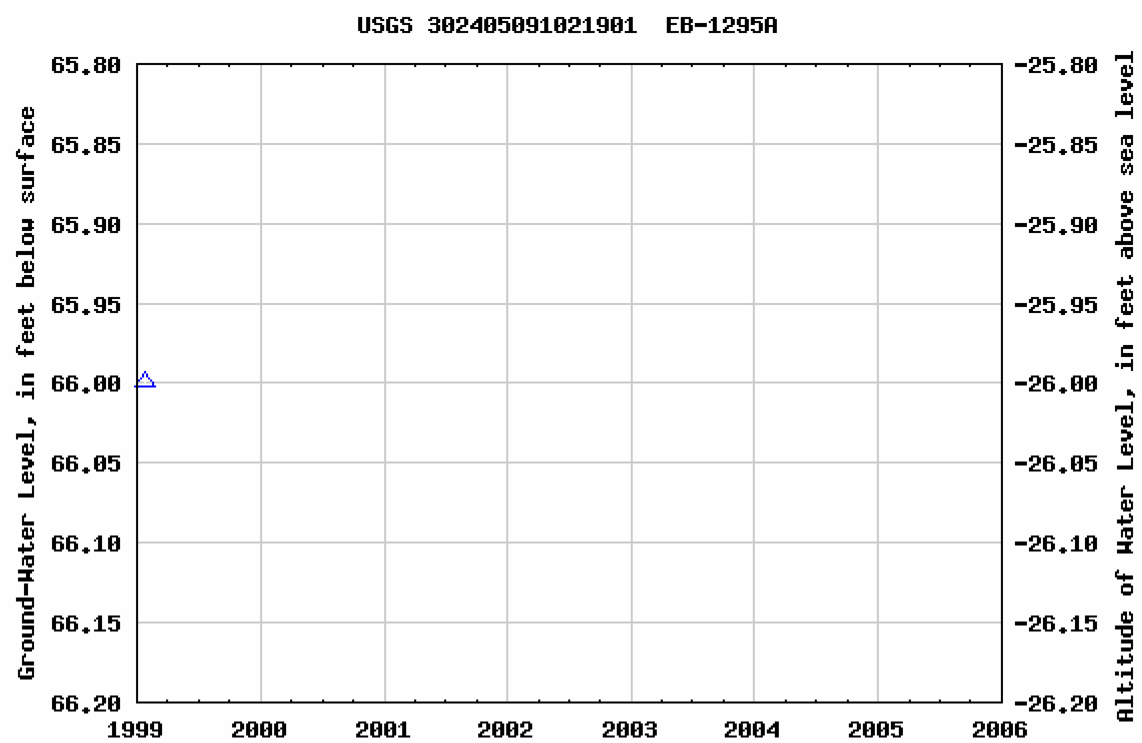

USGS 302514091055401 EB-1136
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
100.80
100.85
100.90
100.95
101.00
101.05
101.10
101.15
101.20
-53.80
-53.85
-53.90
-53.95
-54.00
-54.05
-54.10
-54.15
-54.20
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

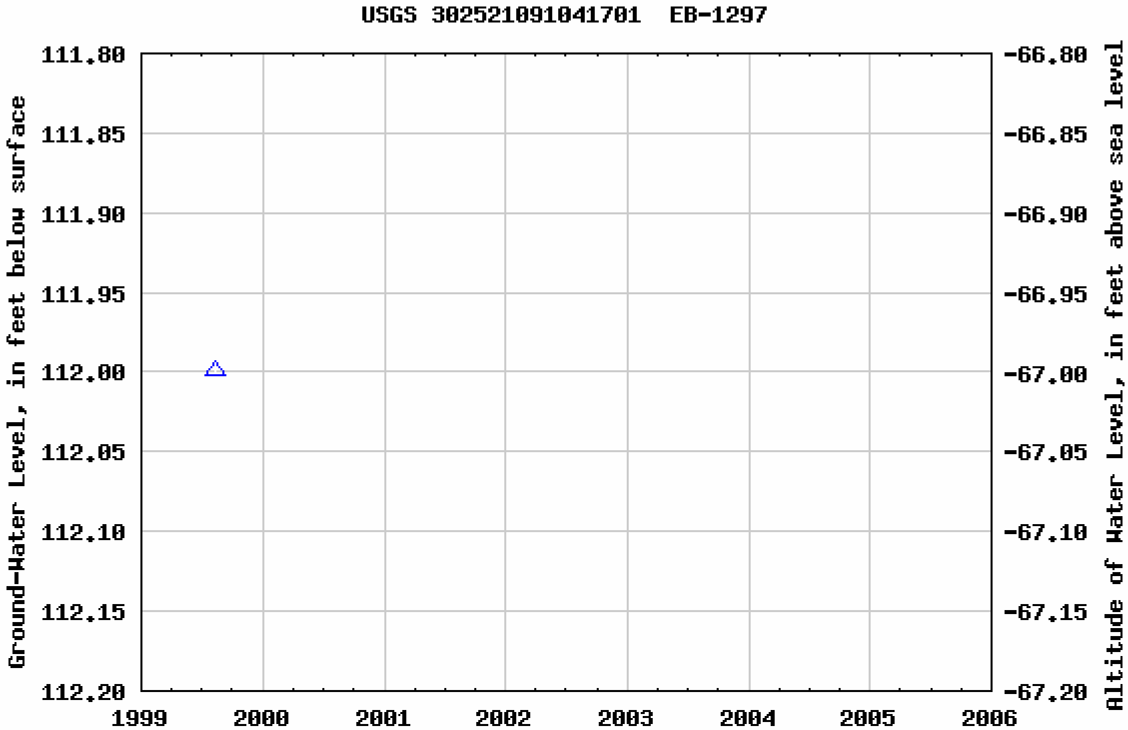

USGS 302358091021901 EB-1163
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
49.80
49.85
49.90
49.95
50.00
50.05
50.10
50.15
50.20
-7.80
-7.85
-7.90
-7.95
-8.00
-8.05
-8.10
-8.15
-8.20
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006


USGS 302317091023601 EB-1219
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
14.80
14.85
14.90
14.95
15.00
15.05
15.10
15.15
15.20
20.20
20.15
20.10
20.05
20.00
19.95
19.90
19.85
19.80
1990 1992 1994 1996 1998 2000 2002 2004 2006

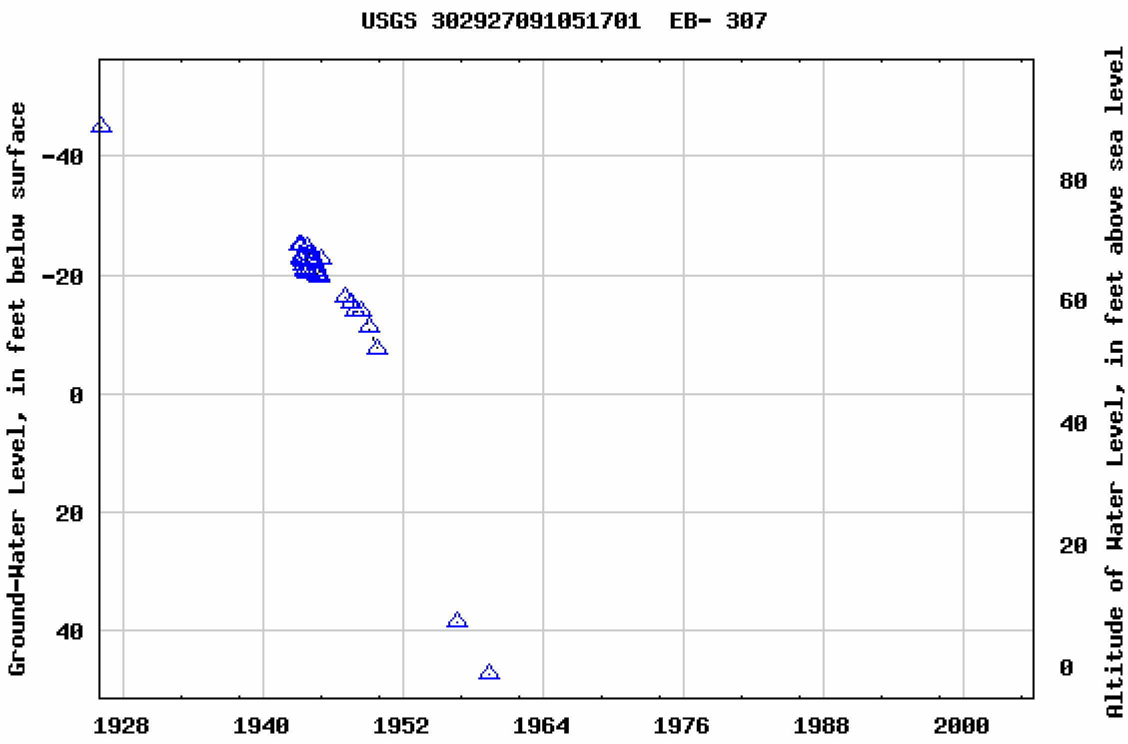

USGS 302317091023201 EB-1244
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
11.80
11.85
11.90
11.95
12.00
12.05
12.10
12.15
12.20
18.20
18.15
18.10
18.05
18.00
17.95
17.90
17.85
17.80
1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006


USGS 302522091041901 EB-1287
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
106.80
106.85
106.90
106.95
107.00
107.05
107.10
107.15
107.20
-61.80
-61.85
-61.90
-61.95
-62.00
-62.05
-62.10
-62.15
-62.20
1998
1999
2000
2001
2002
2003
2004
2005
2006

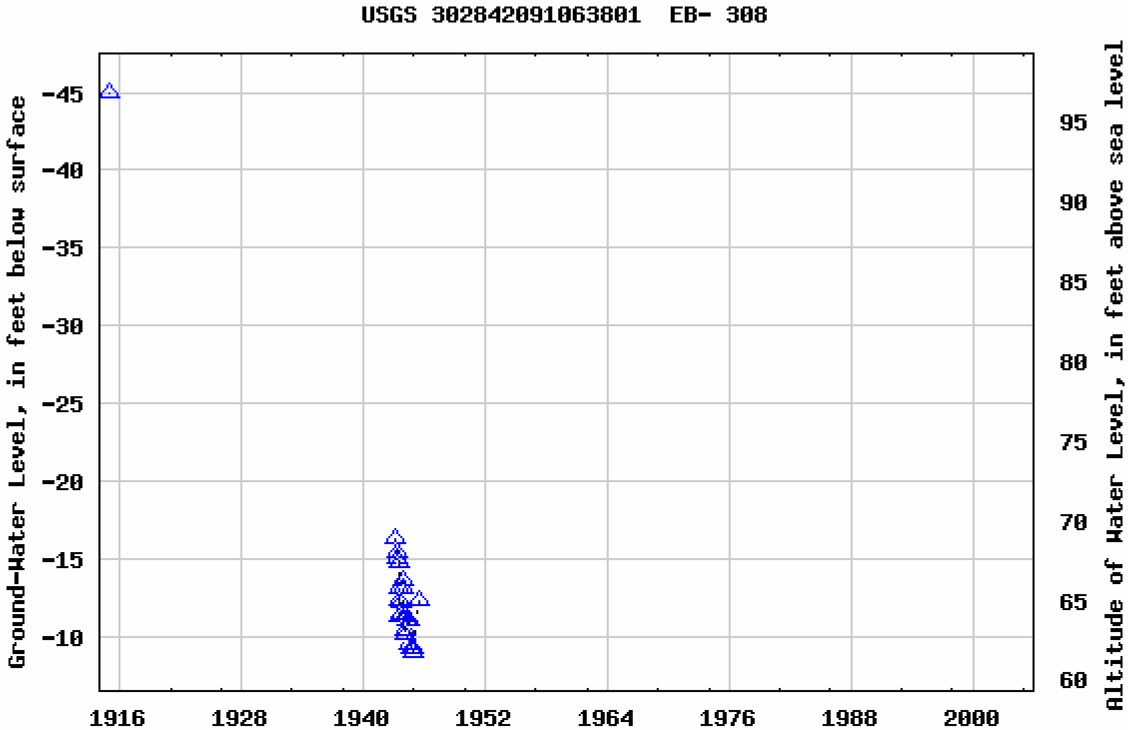

USGS 302405091021901 EB-1295A
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
65.80
65.85
65.90
65.95
66.00
66.05
66.10
66.15
66.20
-25.80
-25.85
-25.90
-25.95
-26.00
-26.05
-26.10
-26.15
-26.20
1999
2000
2001
2002
2003
2004
2005
2006

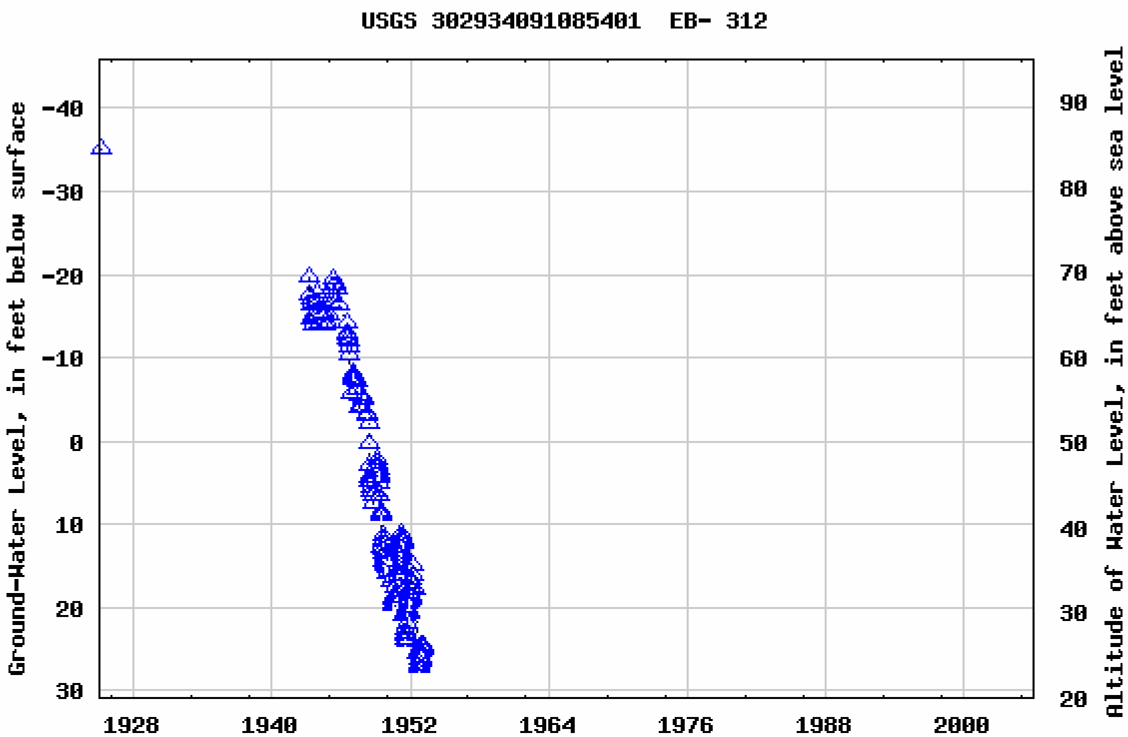


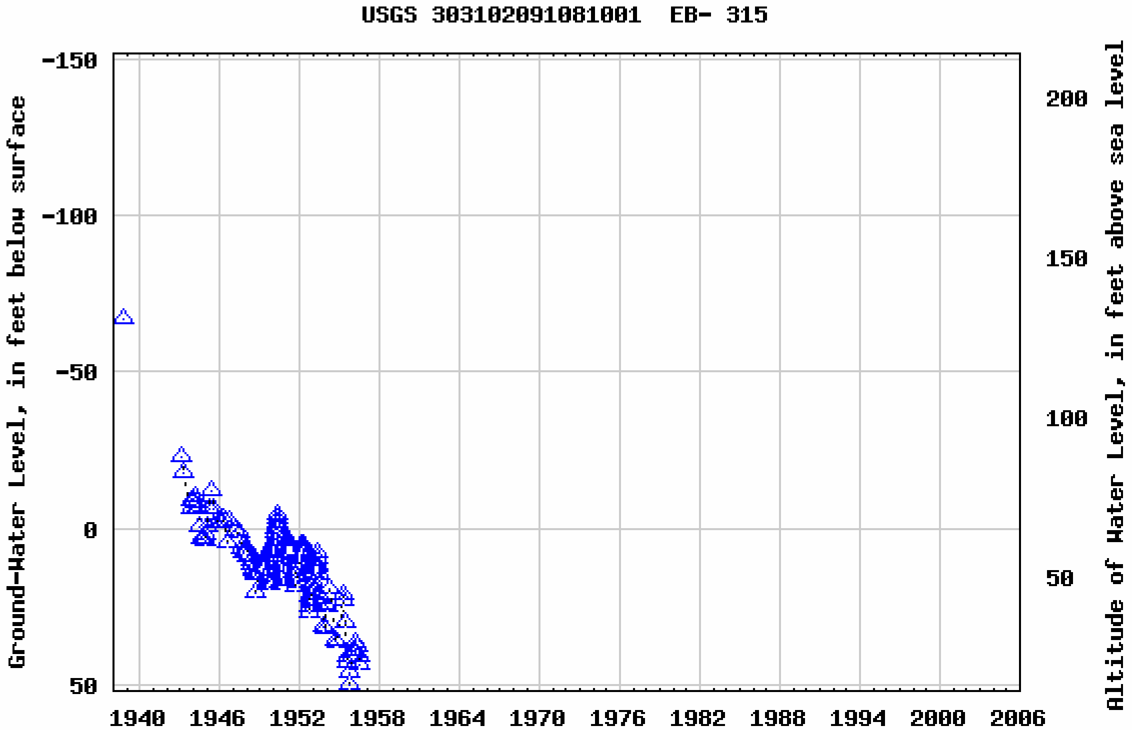
USGS 302521091041701 EB-1297
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
111.80
111.85
111.90
111.95
112.00
112.05
112.10
112.15
112.20
-66.80
-66.85
-66.90
-66.95
-67.00
-67.05
-67.10
-67.15
-67.20
1999
2000
2001
2002
2003
2004
2005
2006

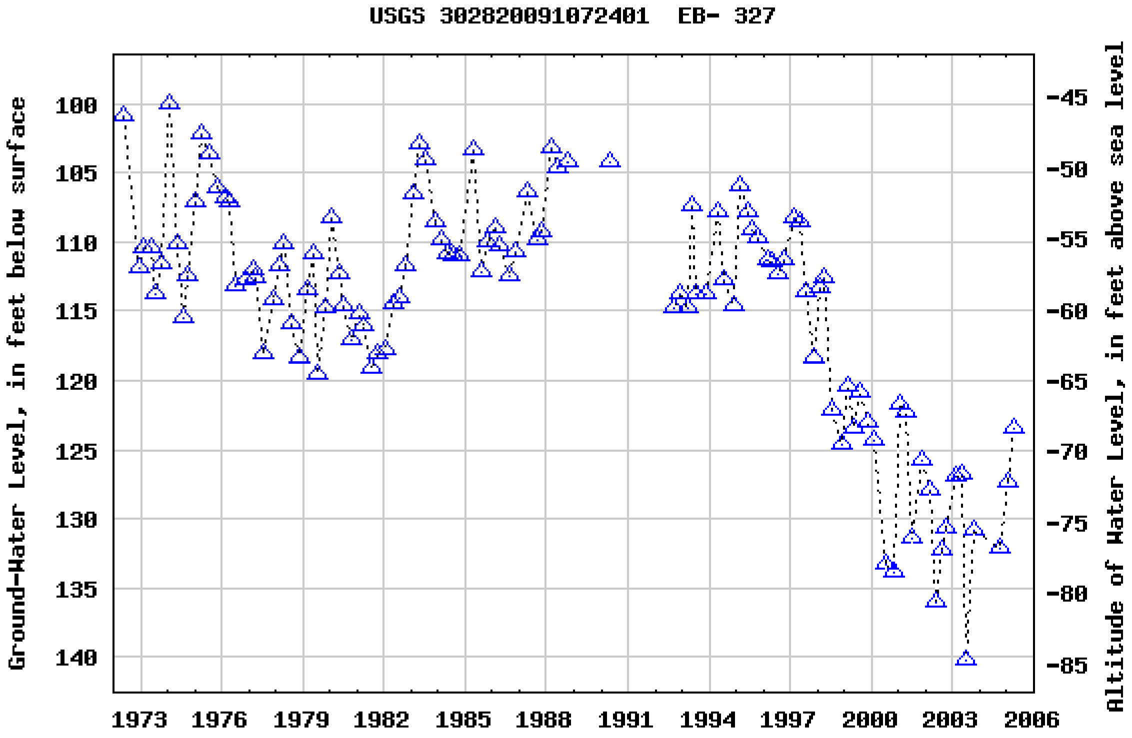


USGS 302927091051701 EB- 307
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-40
-20
0
20
40
80
60
40
20
0
1928
1940
1952
1964
1976
1988
2000

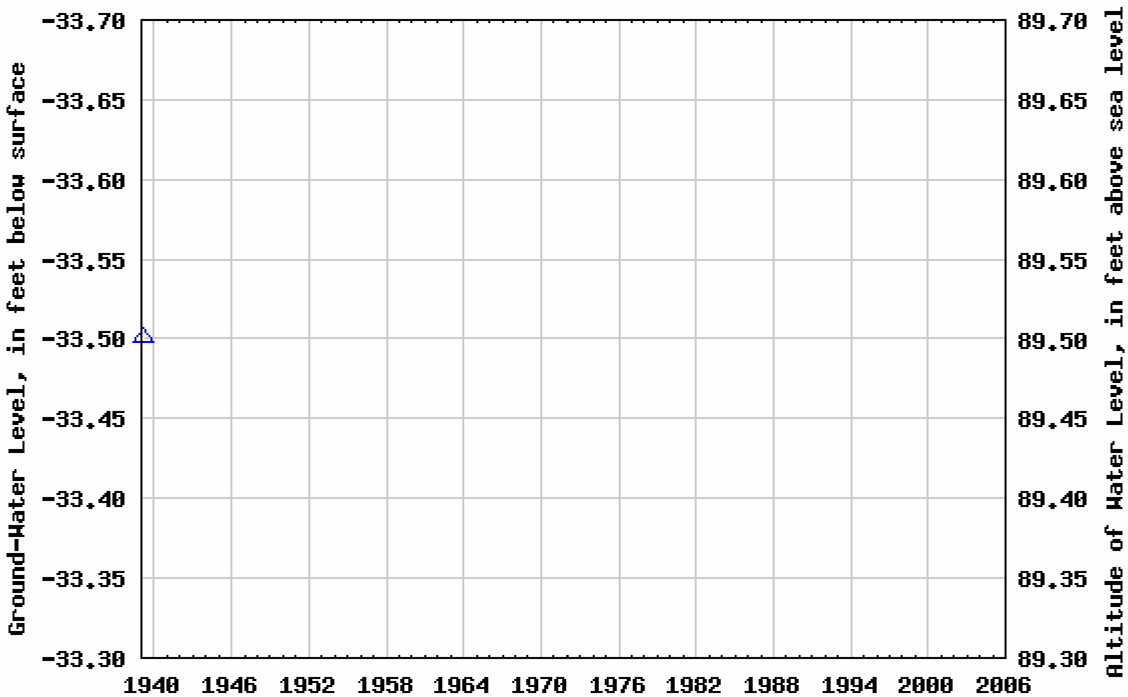

USGS 302842091063801 EB- 308
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-45
-40
-35
-30
-25
-20
-15
-10
95
90
85
80
75
70
65
60
1916
1928
1940
1952
1964
1976
1988
2000


USGS 302934091085401 EB- 312
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-40
-30
-20
-10
0
10
20
30
90
80
70
60
50
40
30
20
1928
1940
1952
1964
1976
1988
2000

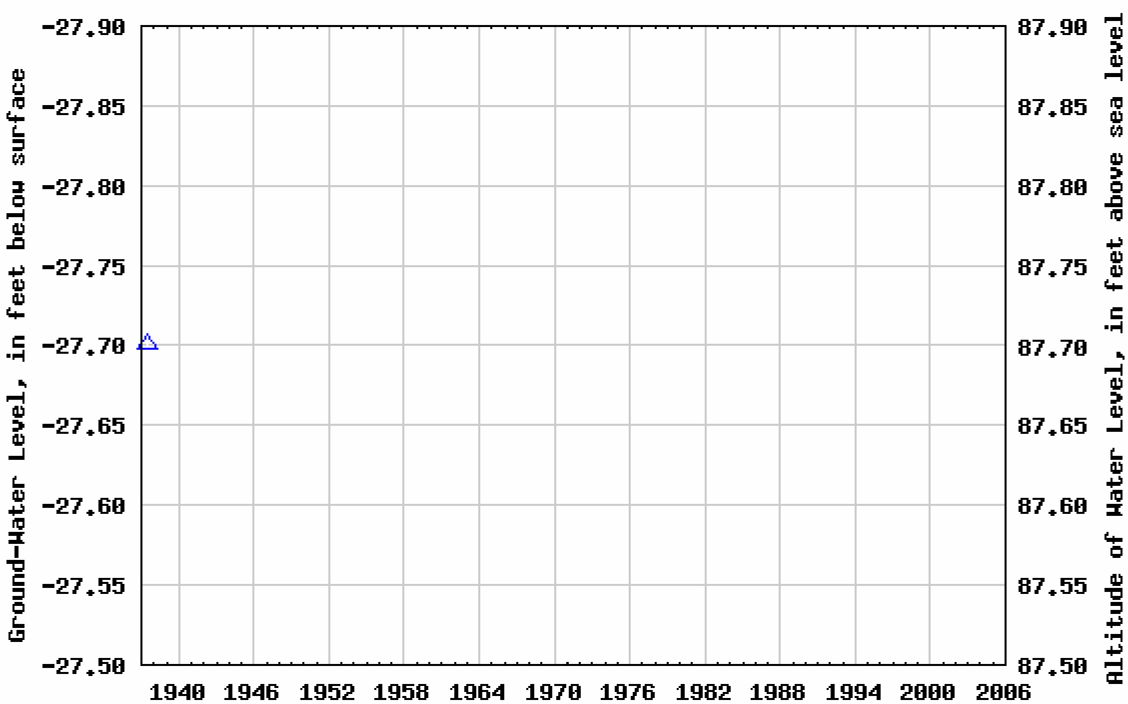

USGS 303102091081001 EB- 315
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-150
-100
-50
0
50
200
150
100
50
1940
1946
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006

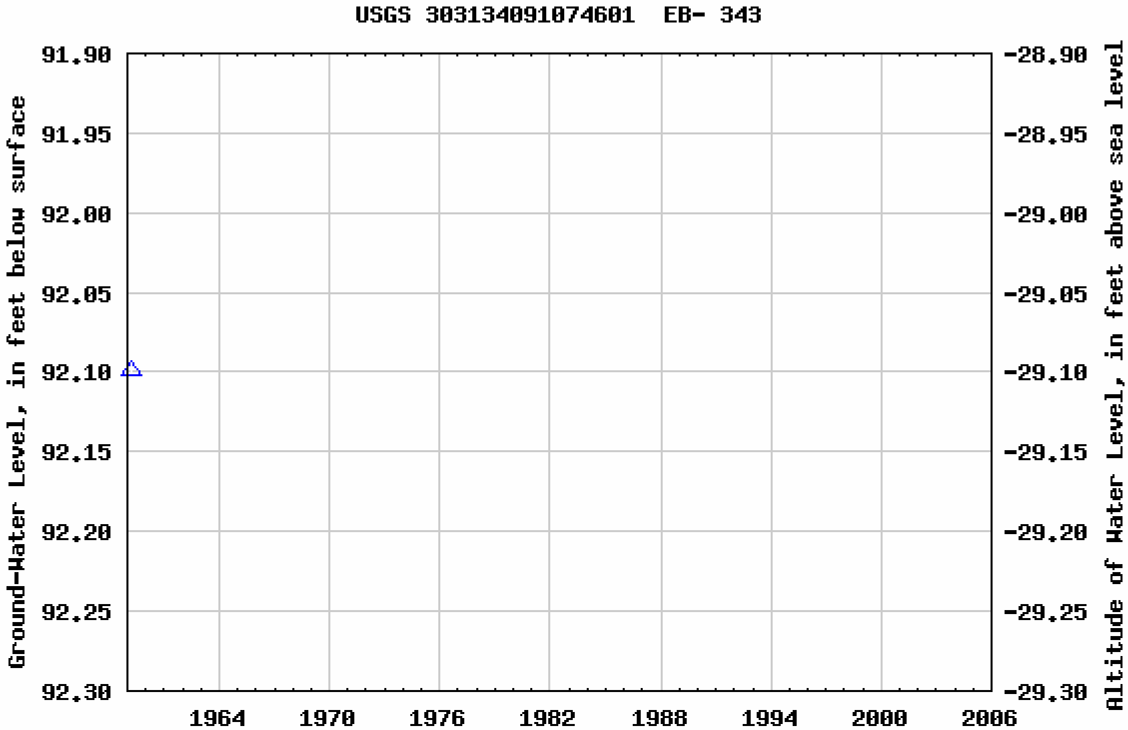

USGS 302820091072401 EB- 327
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
100
105
110
115
120
125
130
135
140
-45
-50
-55
-60
-65
-70
-75
-80
-85
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

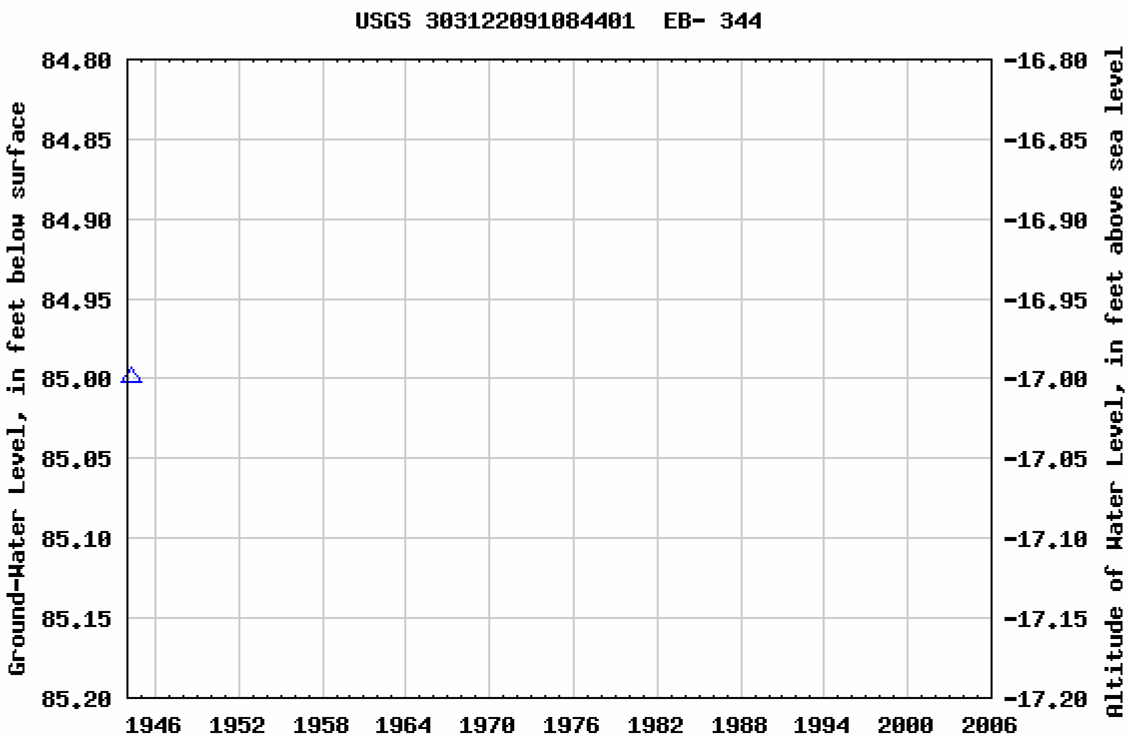
USGS 302842091060801 EB- 328

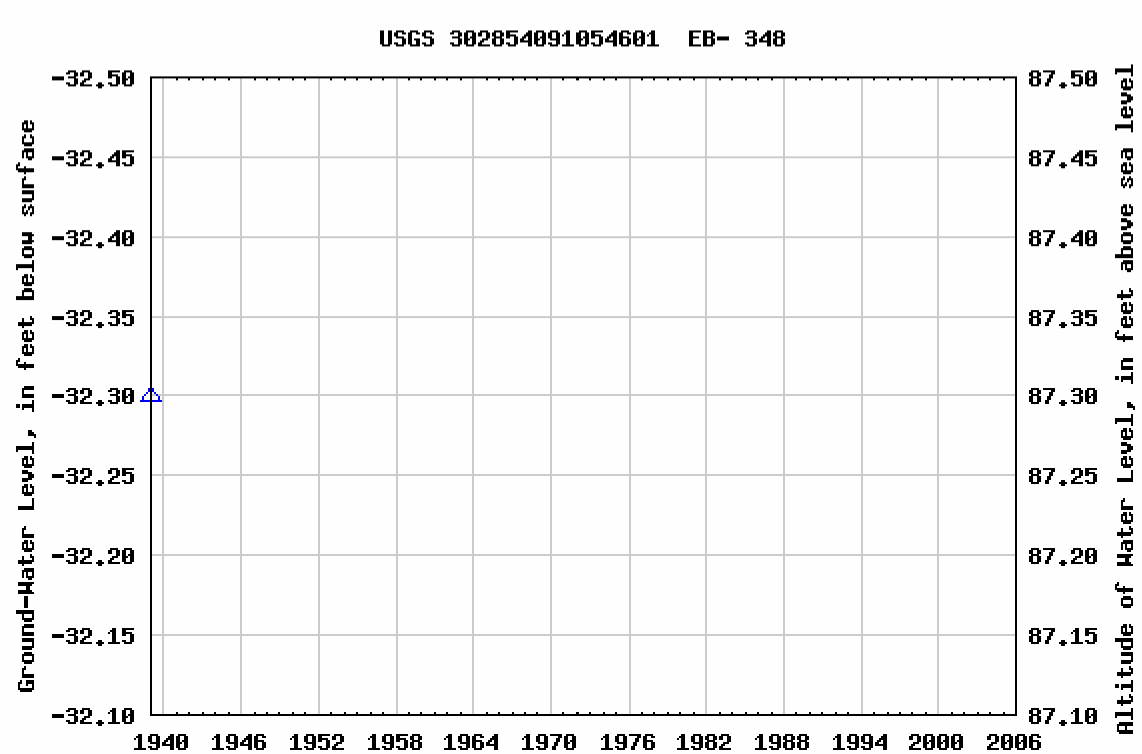


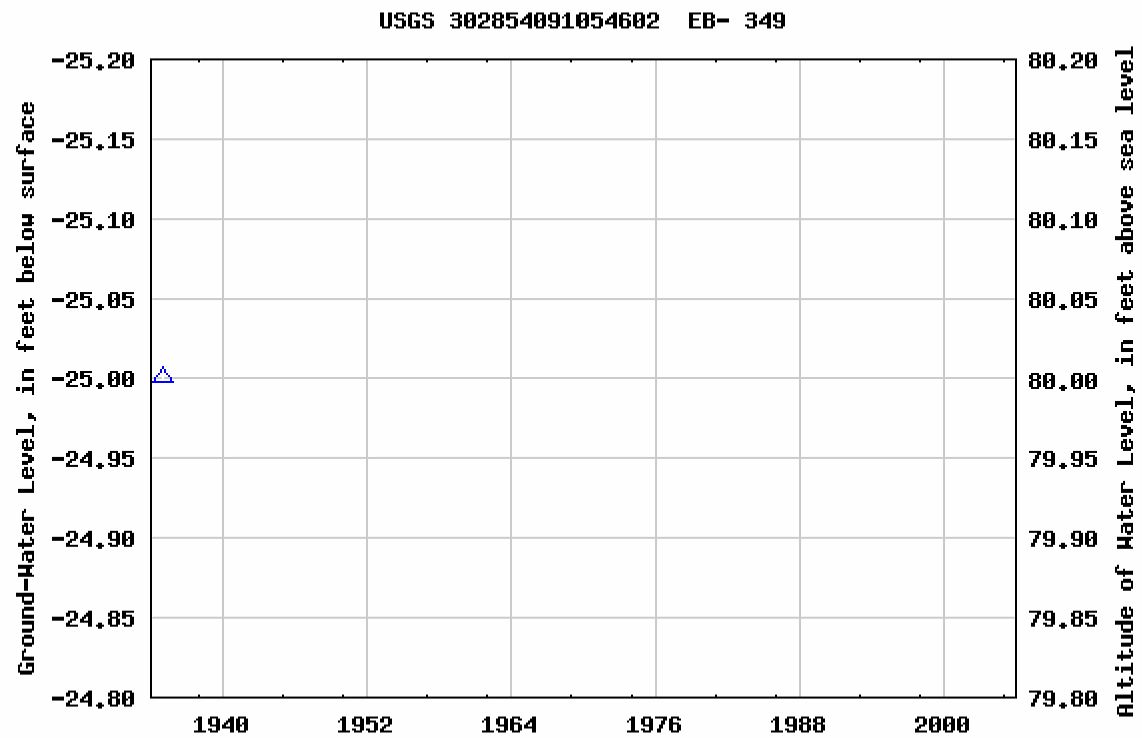
USGS 303131091072401 EB- 342

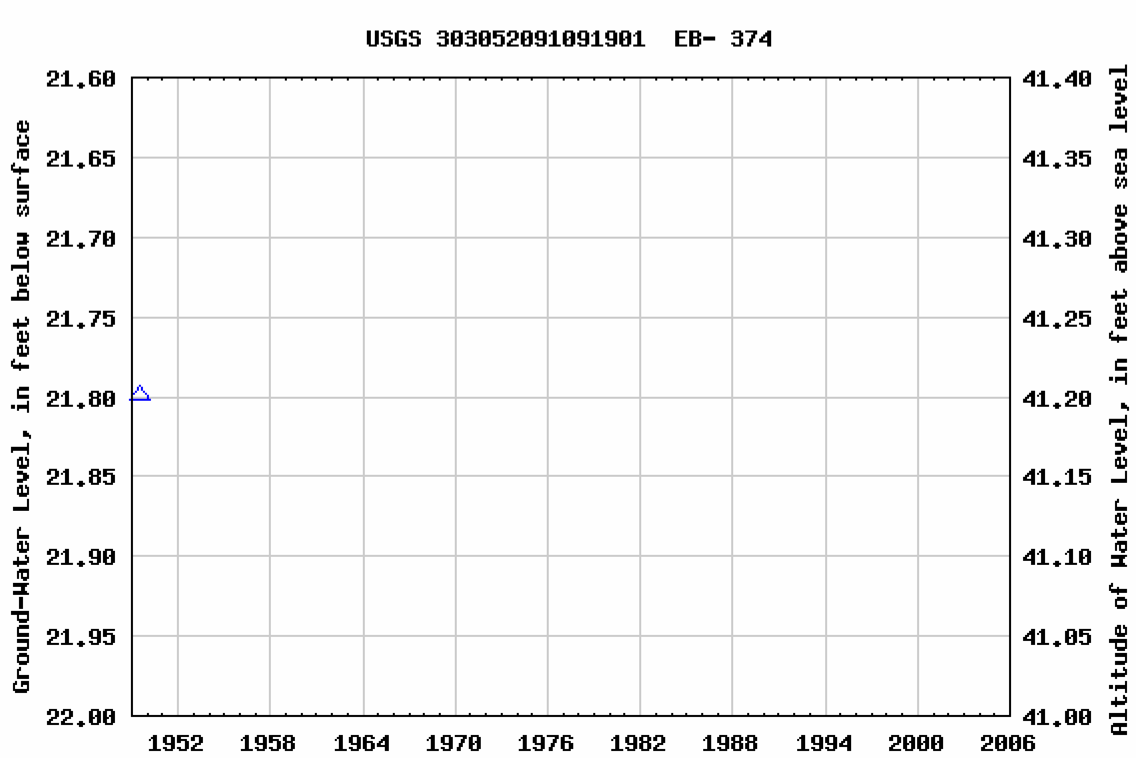


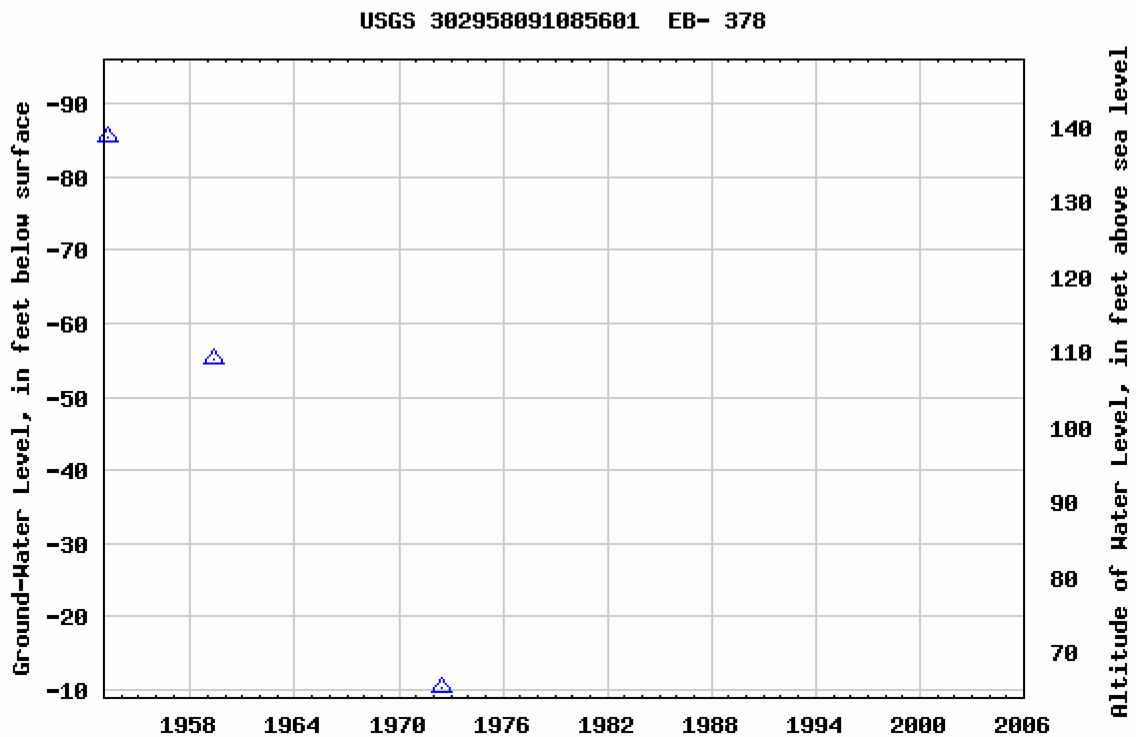

USGS 303134091074601 EB- 343
Ground-Water Level, in feet below surface
91.90
91.95
92.00
92.05
92.10
92.15
92.20
92.25
92.30
1964
1970
1976
1982
1988
1994
2000
2006
-28.90
-28.95
-29.00
-29.05
-29.10
-29.15
-29.20
-29.25
-29.30
Altitude of Water Level, in feet above sea level

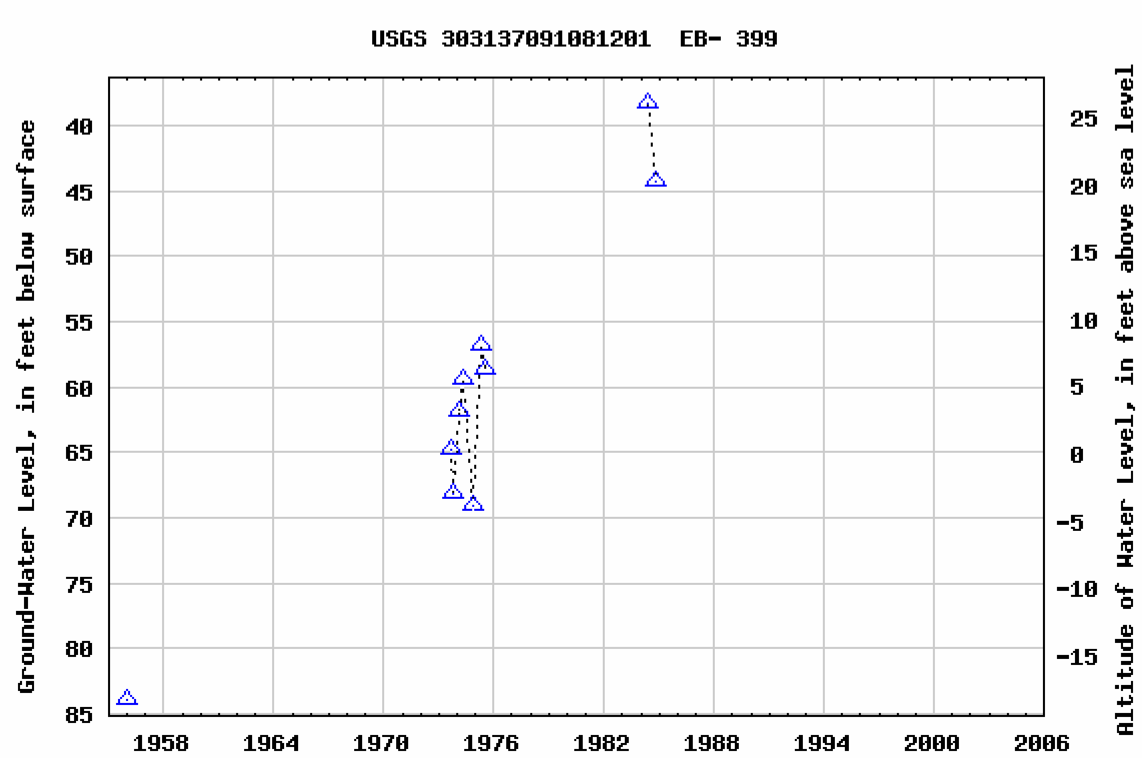

USGS 303122091084401 EB- 344
Ground-Water Level, in feet below surface
84.80
84.85
84.90
84.95
85.00
85.05
85.10
85.15
85.20
1946
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006
-16.80
-16.85
-16.90
-16.95
-17.00
-17.05
-17.10
-17.15
-17.20
Altitude of Water Level, in feet above sea level

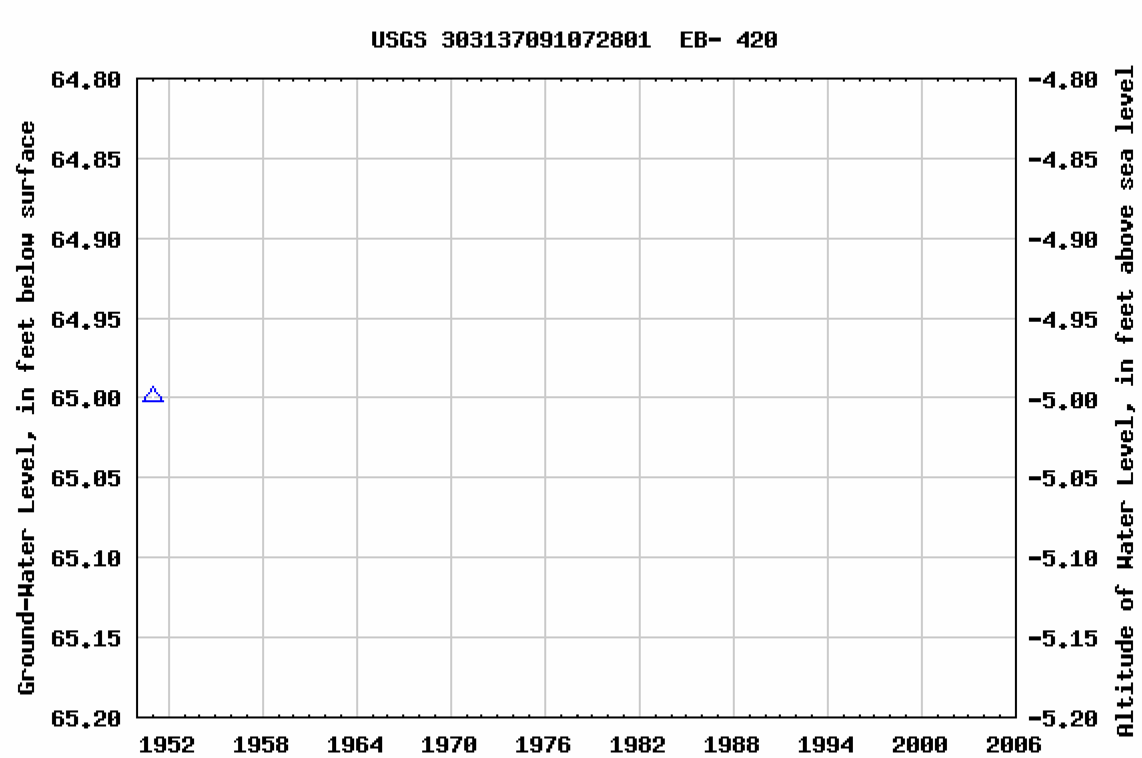

USGS 302854091054601 EB- 348
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-32.50
-32.45
-32.40
-32.35
-32.30
-32.25
-32.20
-32.15
-32.10
87.50
87.45
87.40
87.35
87.30
87.25
87.20
87.15
87.10
1940 1946 1952 1958 1964 1970 1976 1982 1988 1994 2000 2006

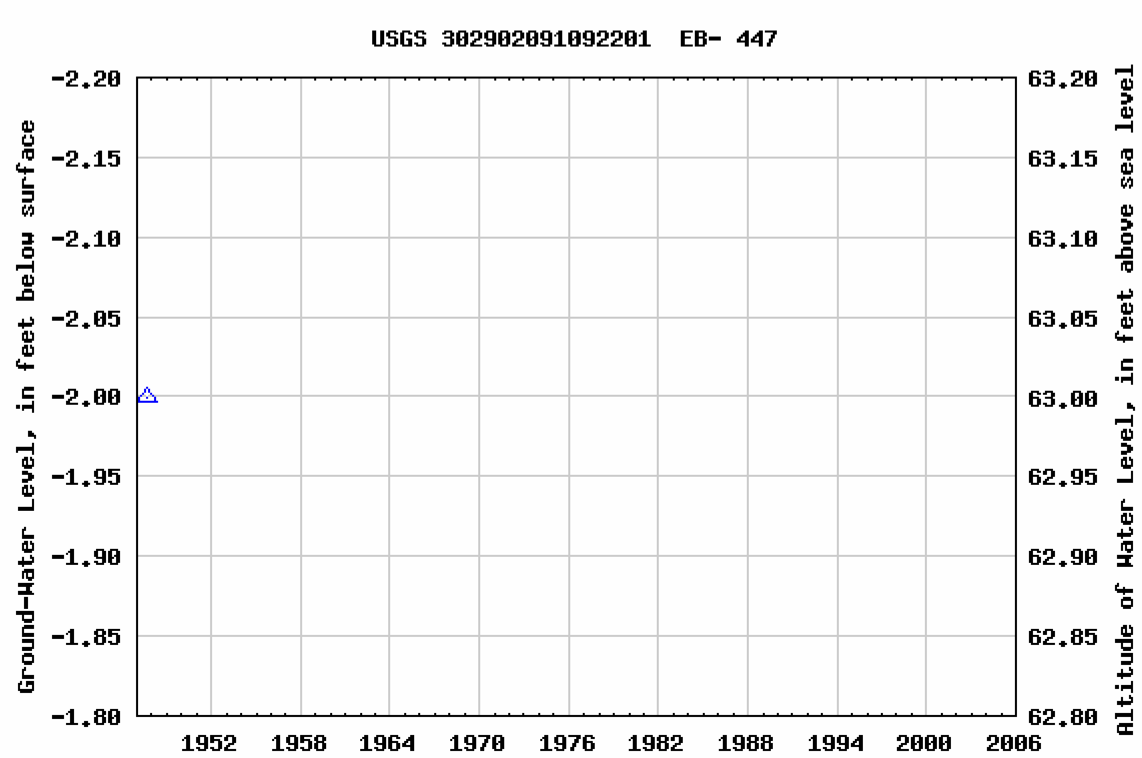

USGS 302854091054602 EB- 349
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-25.20
-25.15
-25.10
-25.05
-25.00
-24.95
-24.90
-24.85
-24.80
80.20
80.15
80.10
80.05
80.00
79.95
79.90
79.85
79.80
1940 1952 1964 1976 1988 2000

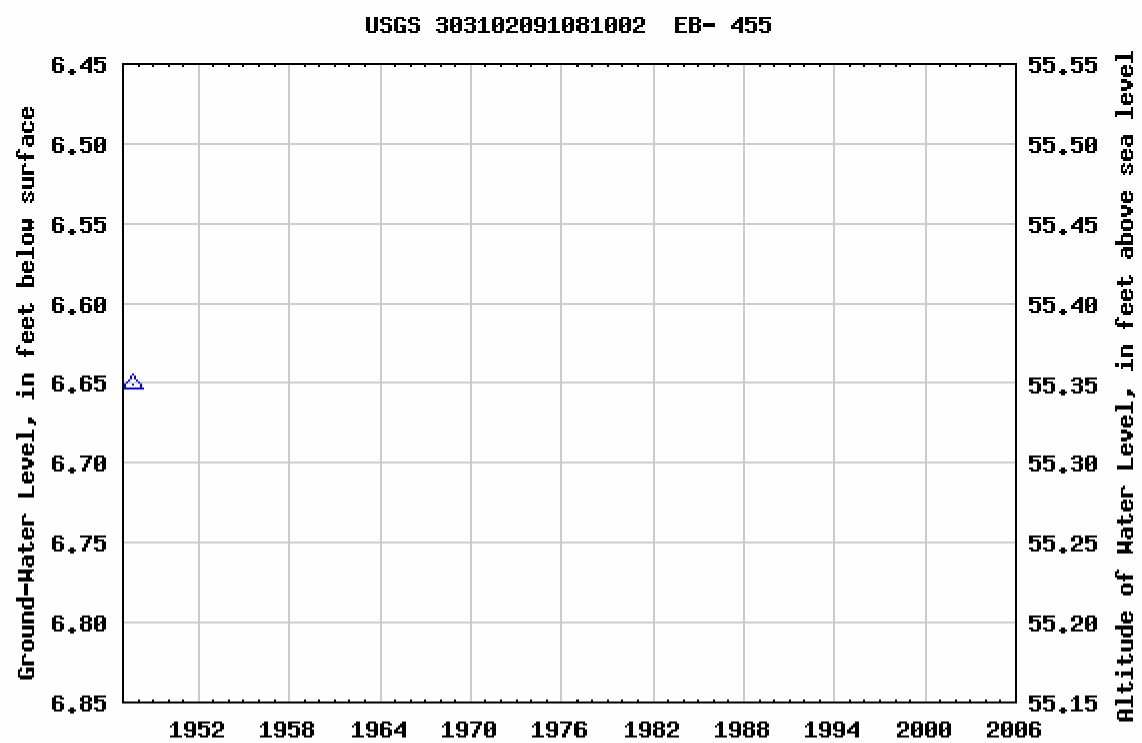

USGS 303052091091901 EB- 374
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
21.60
21.65
21.70
21.75
21.80
21.85
21.90
21.95
22.00
41.40
41.35
41.30
41.25
41.20
41.15
41.10
41.05
41.00
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006

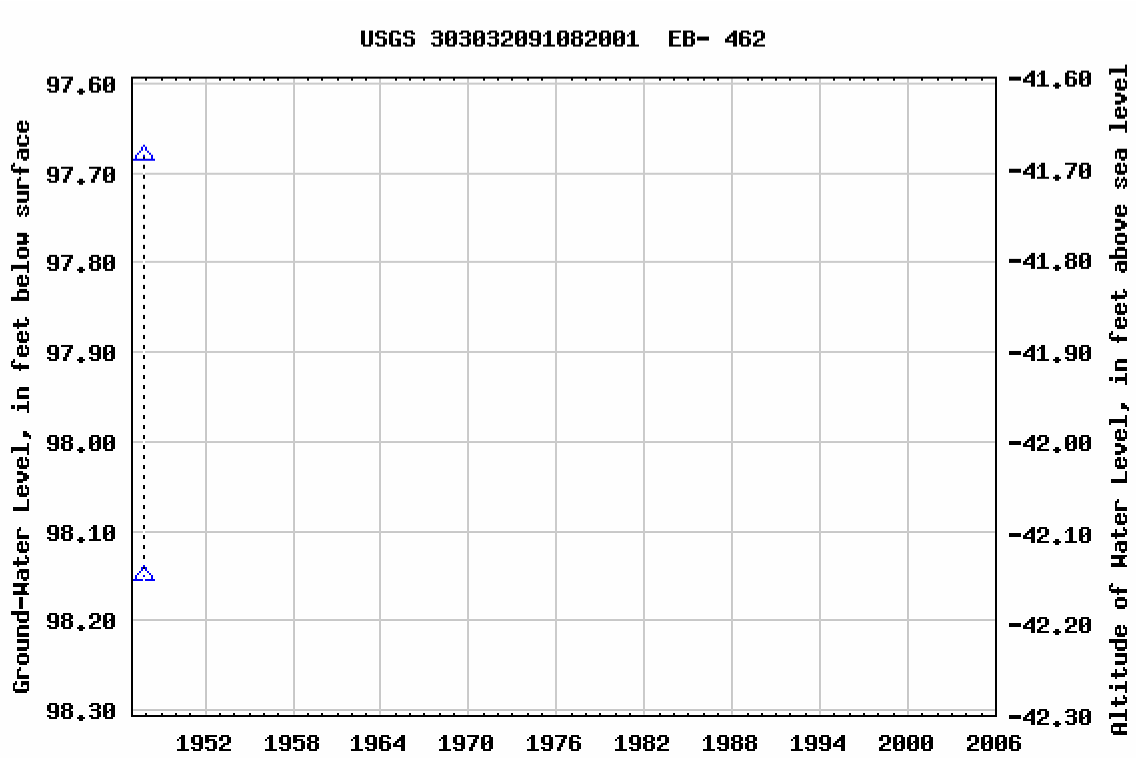

USGS 302958091085601 EB- 378
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
-90
-80
-70
-60
-50
-40
-30
-20
-10
140
130
120
110
100
90
80
70
1958
1964
1970
1976
1982
1988
1994
2000
2006

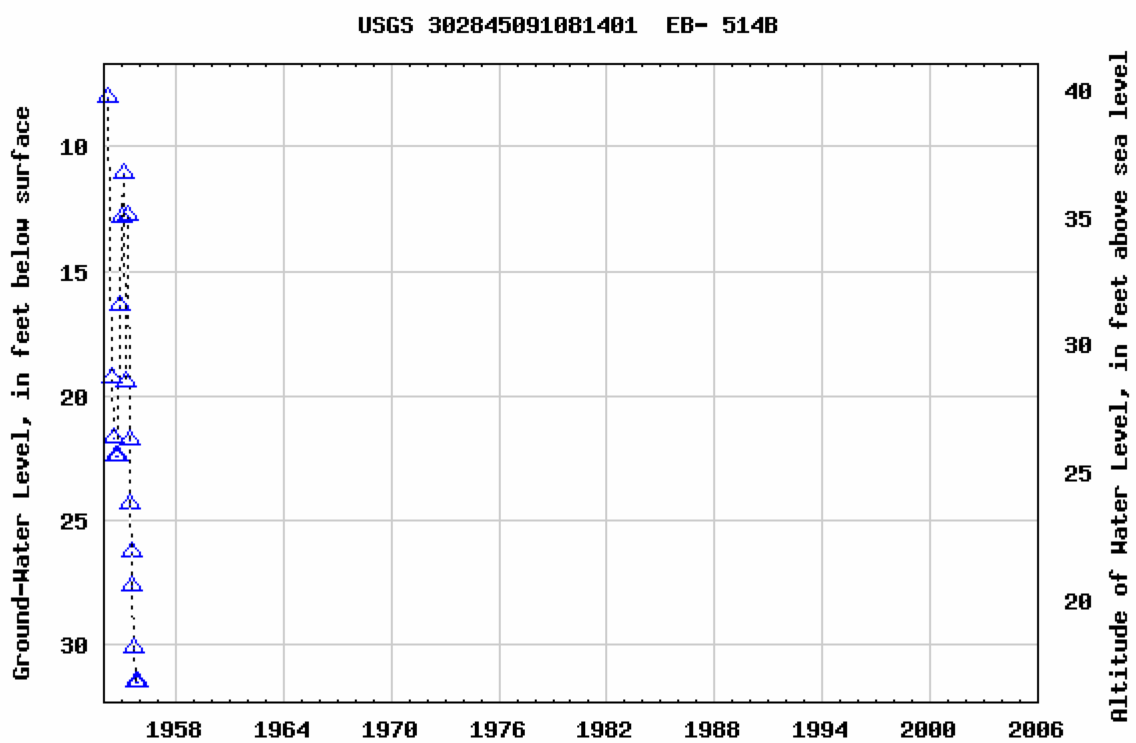

USGS 303137091081201 EB- 399
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
40
45
50
55
60
65
70
75
80
85
25
20
15
10
5
0
-5
-10
-15
1958
1964
1970
1976
1982
1988
1994
2000
2006

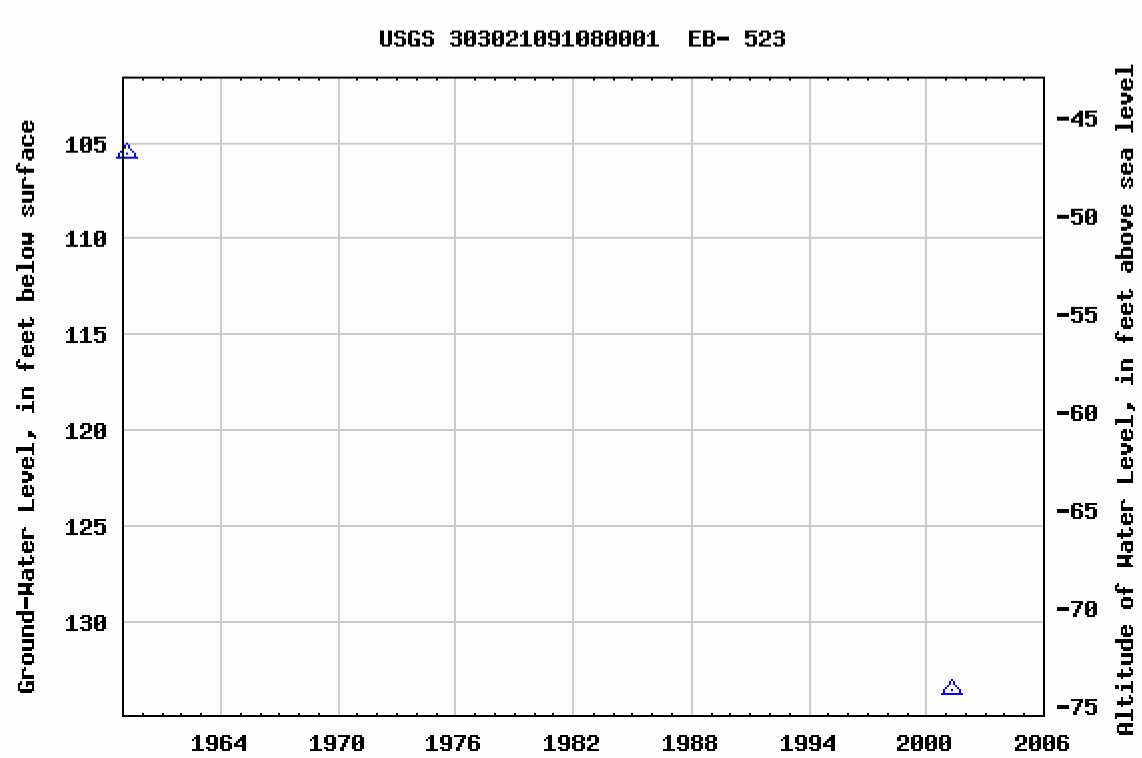

USGS 303137091072801 EB- 420
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
64.80
64.85
64.90
64.95
65.00
65.05
65.10
65.15
65.20
-4.80
-4.85
-4.90
-4.95
-5.00
-5.05
-5.10
-5.15
-5.20
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006

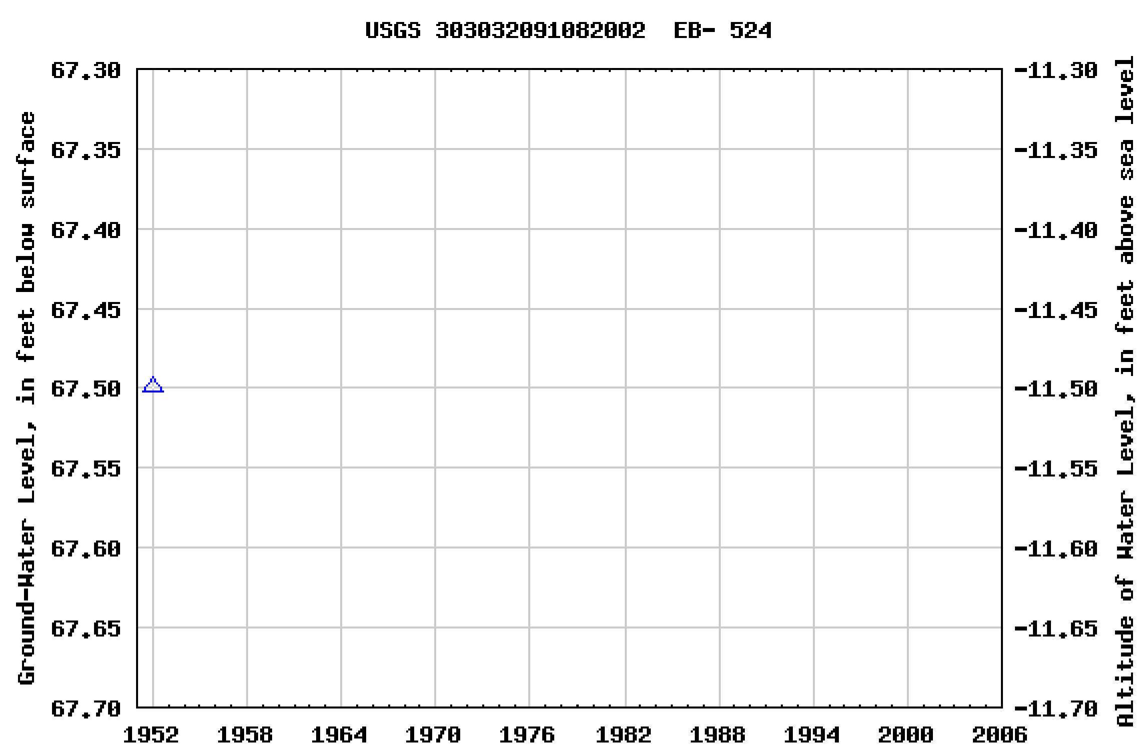

USGS 302902091092201 EB- 447
Ground-Water Level, in feet below surface
-2.20
-2.15
-2.10
-2.05
-2.00
-1.95
-1.90
-1.85
-1.80
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006
63.20
63.15
63.10
63.05
63.00
62.95
62.90
62.85
62.80
Altitude of Water Level, in feet above sea level

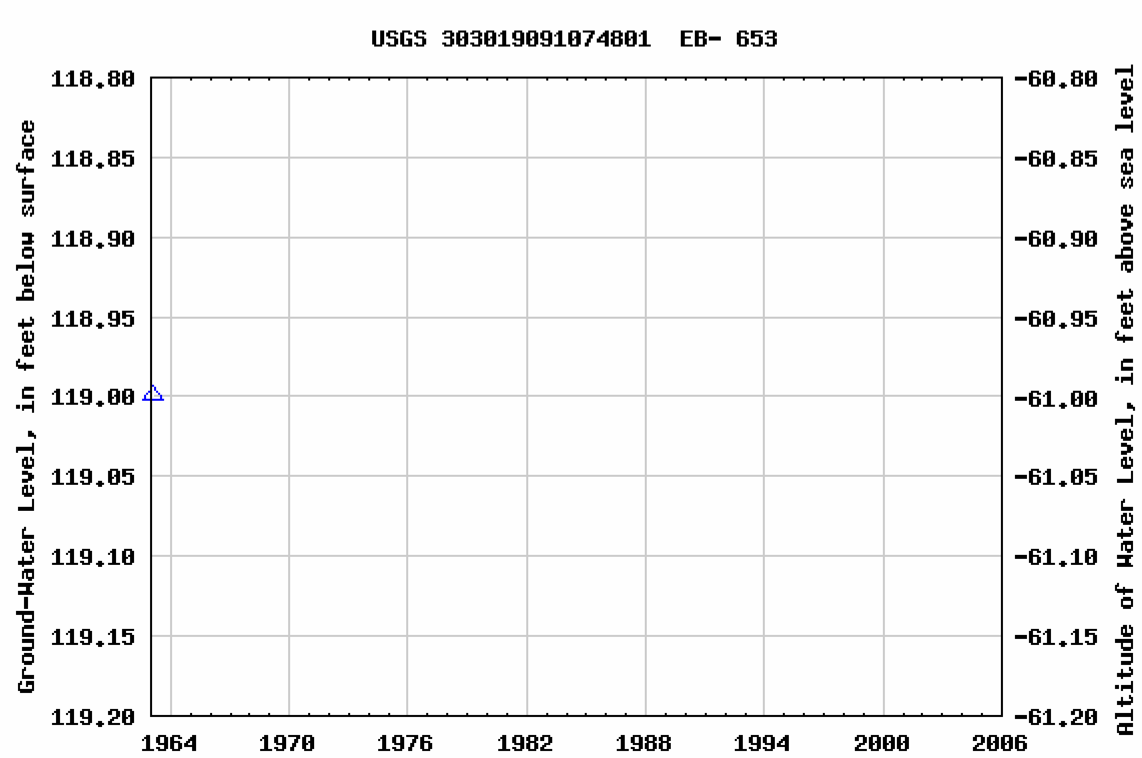

USGS 303102091081002 EB- 455
Ground-Water Level, in feet below surface
6.45
6.50
6.55
6.60
6.65
6.70
6.75
6.80
6.85
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006
55.55
55.50
55.45
55.40
55.35
55.30
55.25
55.20
55.15
Altitude of Water Level, in feet above sea level

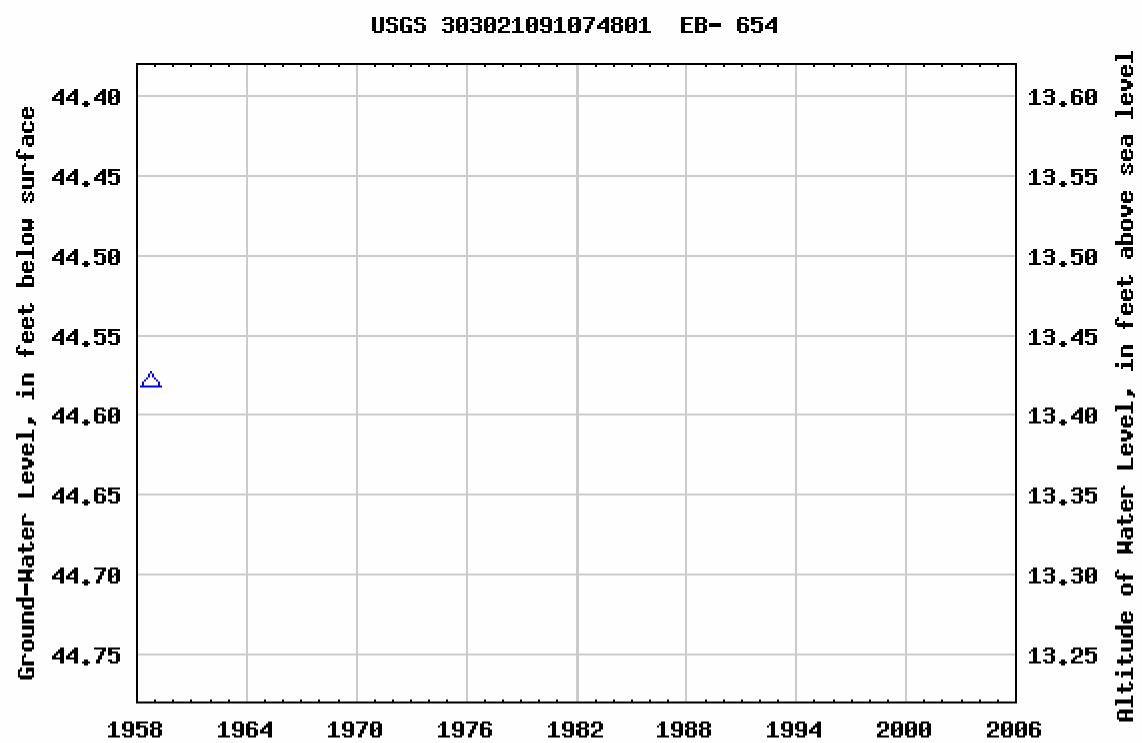

USGS 303032091082001 EB- 462
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
97.60
97.70
97.80
97.90
98.00
98.10
98.20
98.30
-41.60
-41.70
-41.80
-41.90
-42.00
-42.10
-42.20
-42.30
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006

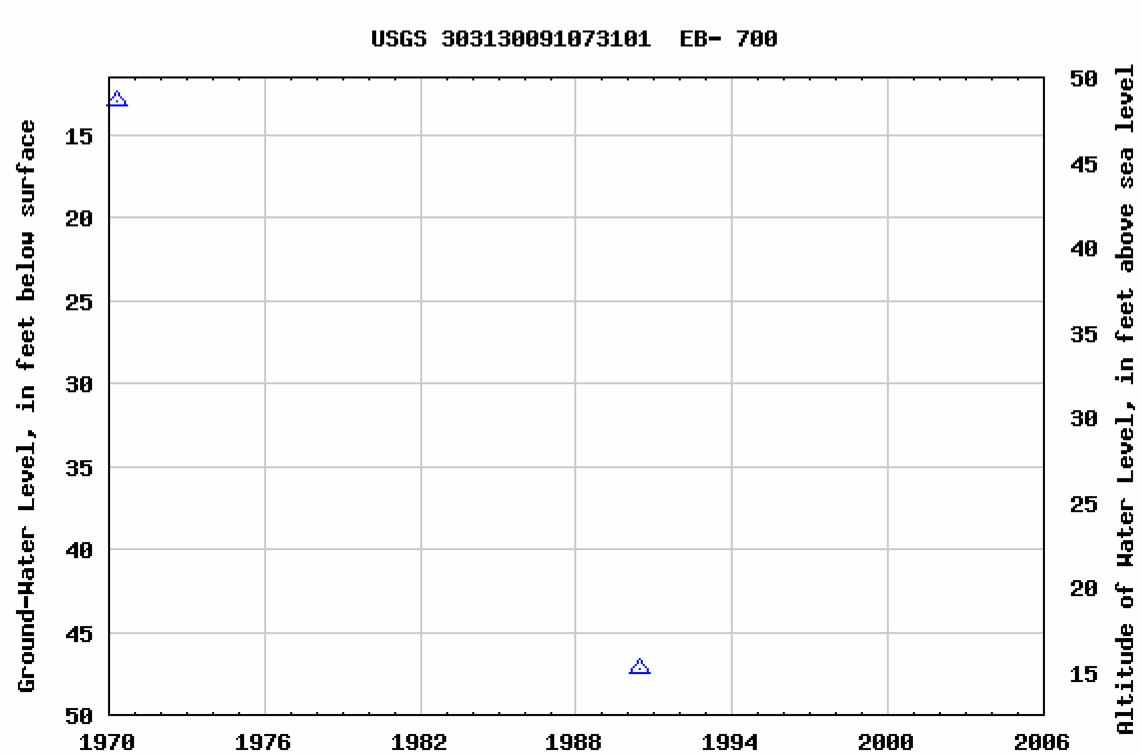

USGS 302845091081401 EB- 514B
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
10
15
20
25
30
40
35
30
25
20
1958
1964
1970
1976
1982
1988
1994
2000
2006


USGS 303021091080001 EB- 523
Ground-Water Level, in feet below surface
105
110
115
120
125
130
1964
1970
1976
1982
1988
1994
2000
2006
-45
-50
-55
-60
-65
-70
-75
Altitude of Water Level, in feet above sea level

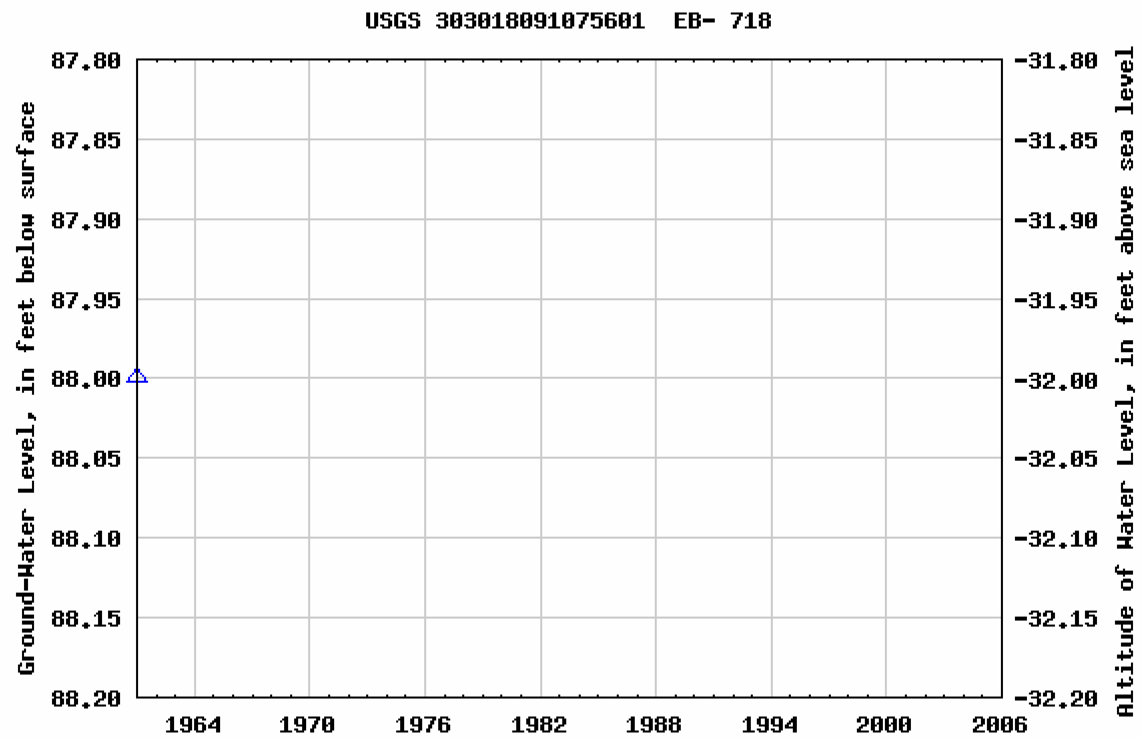

USGS 303032091082002 EB- 524
Ground-Water Level, in feet below surface
67.30
67.35
67.40
67.45
67.50
67.55
67.60
67.65
67.70
1952
1958
1964
1970
1976
1982
1988
1994
2000
2006
-11.30
-11.35
-11.40
-11.45
-11.50
-11.55
-11.60
-11.65
-11.70
Altitude of Water Level, in feet above sea level


USGS 303019091074801 EB- 653
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
118.80
118.85
118.90
118.95
119.00
119.05
119.10
119.15
119.20
-60.80
-60.85
-60.90
-60.95
-61.00
-61.05
-61.10
-61.15
-61.20
1964
1970
1976
1982
1988
1994
2000
2006

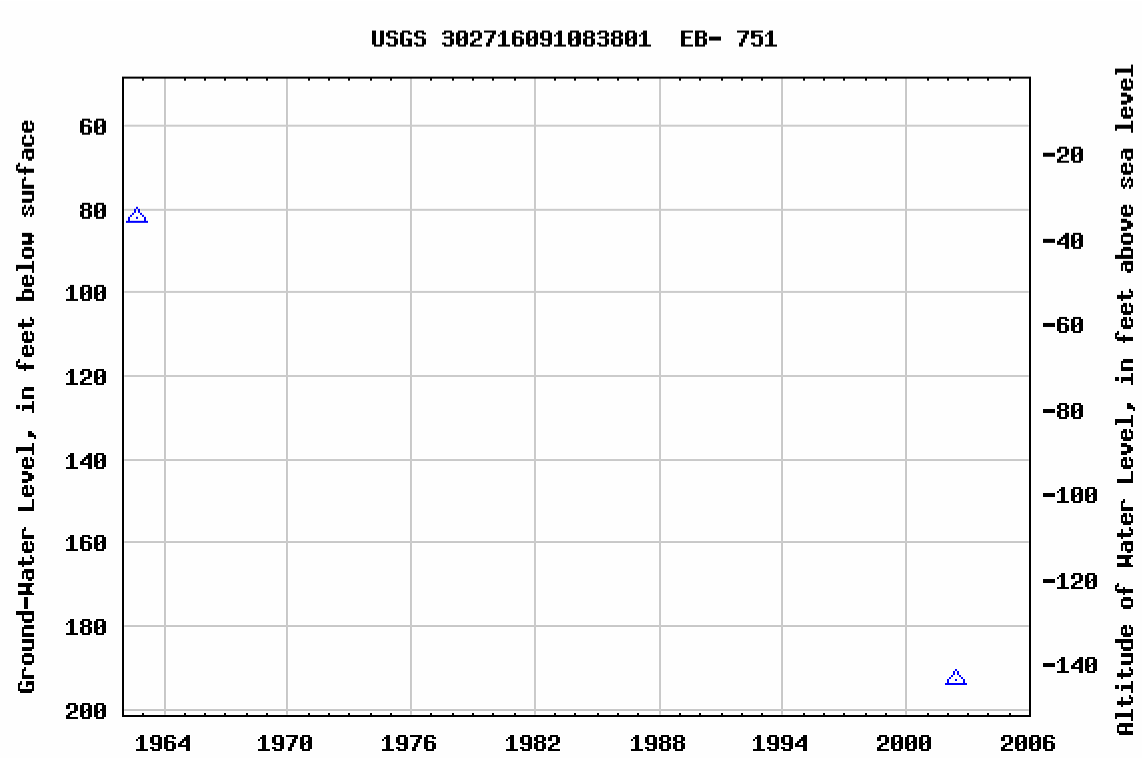

USGS 303021091074801 EB- 654
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
44.40
44.45
44.50
44.55
44.60
44.65
44.70
44.75
13.60
13.55
13.50
13.45
13.40
13.35
13.30
13.25
1958
1964
1970
1976
1982
1988
1994
2000
2006

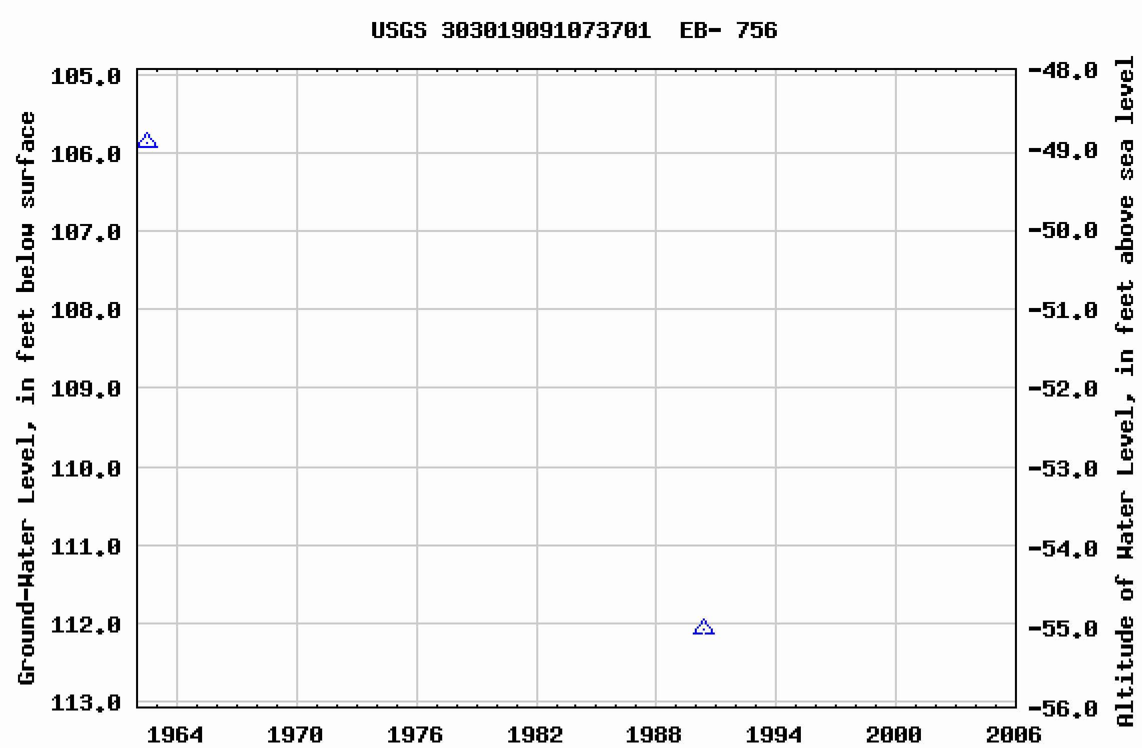


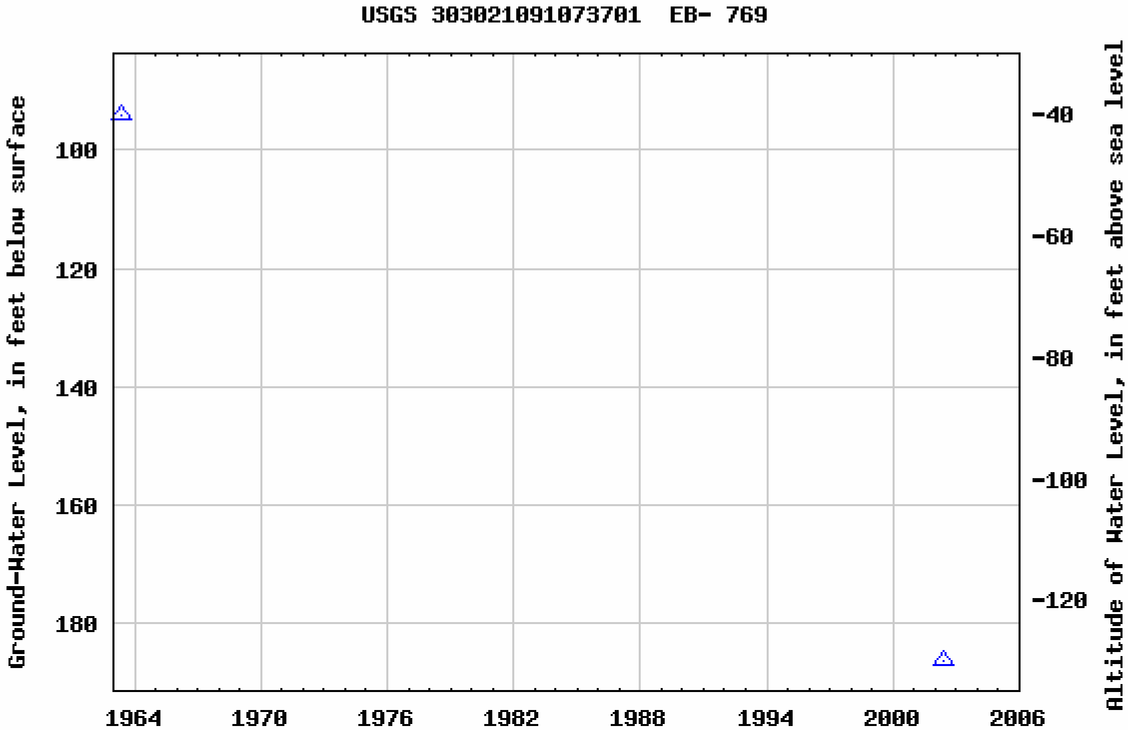
USGS 303130091073101 EB- 700
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
15
20
25
30
35
40
45
50
1970
1976
1982
1988
1994
2000
2006

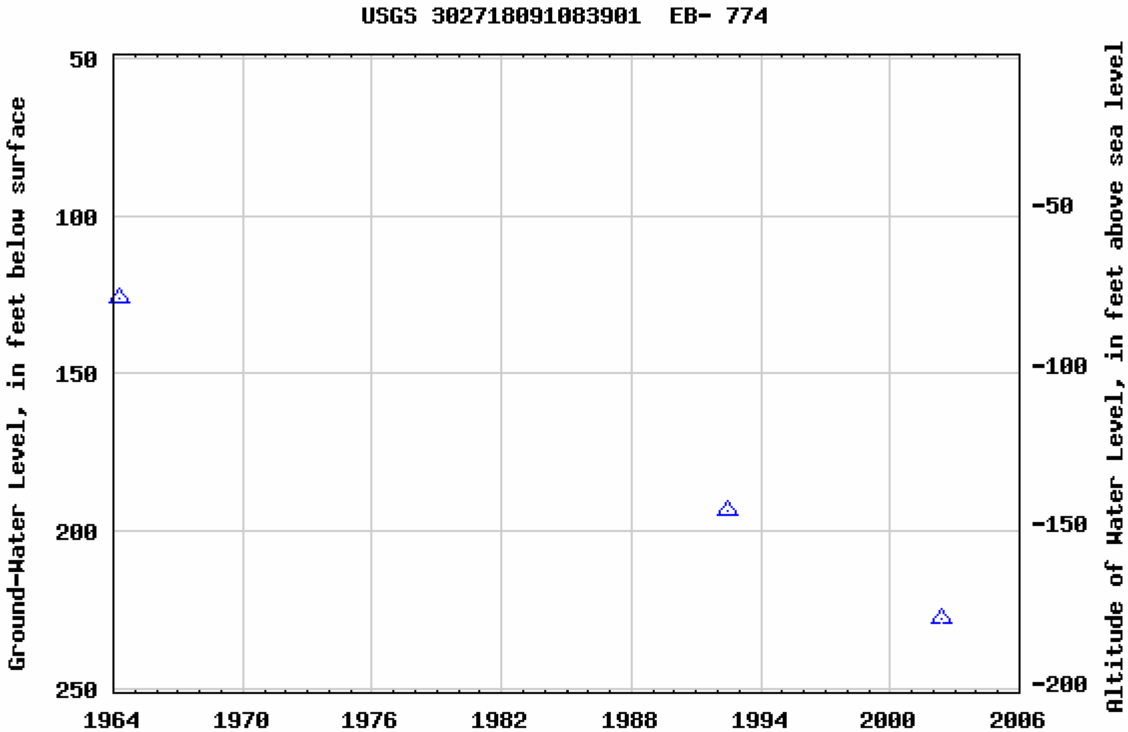


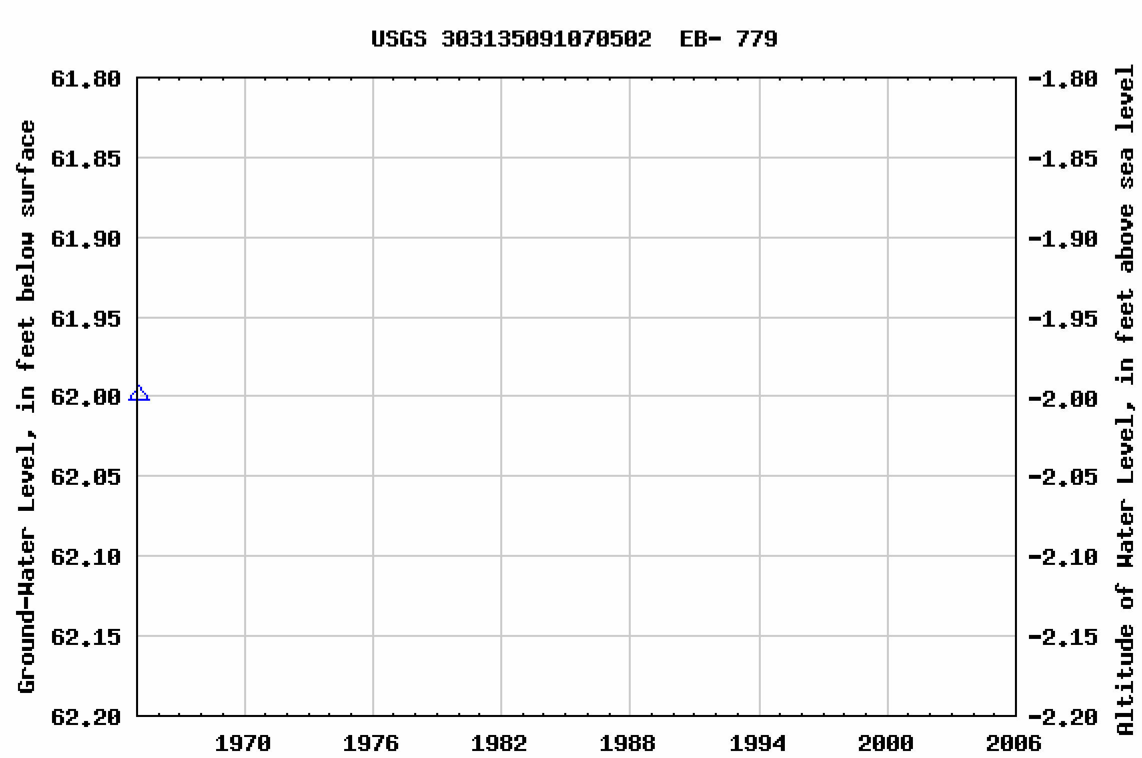
USGS 303018091075601 EB- 718
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
87.80
87.85
87.90
87.95
88.00
88.05
88.10
88.15
88.20
-31.80
-31.85
-31.90
-31.95
-32.00
-32.05
-32.10
-32.15
-32.20
1964
1970
1976
1982
1988
1994
2000
2006

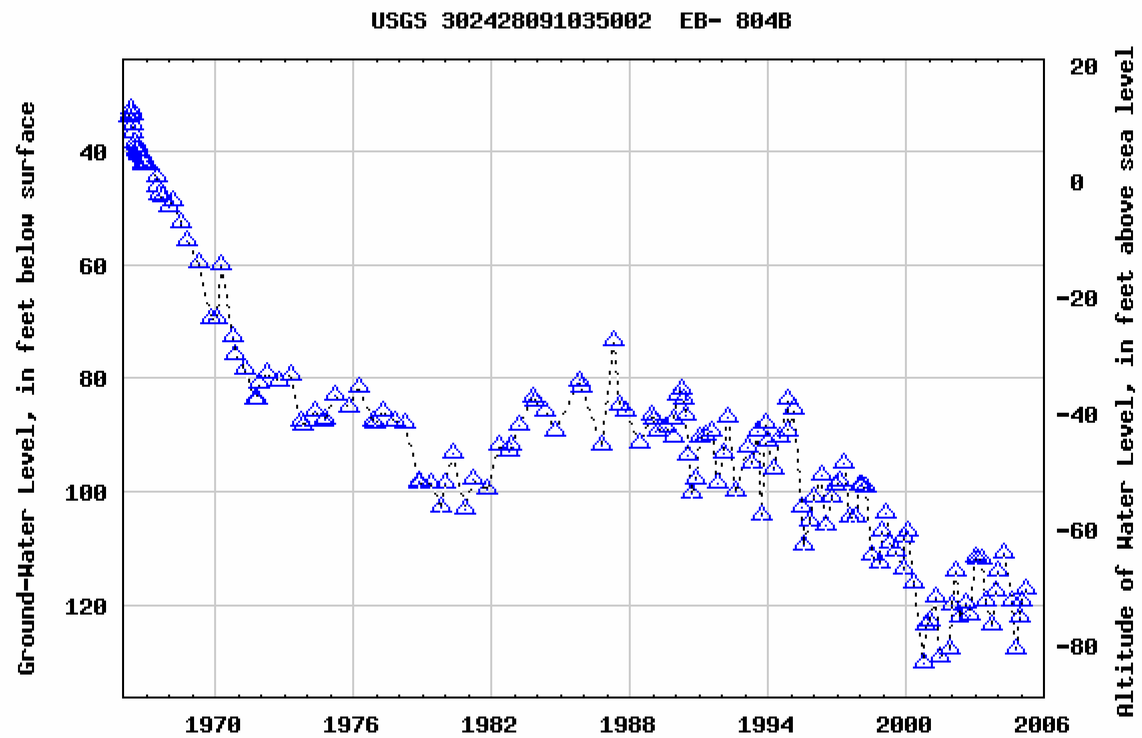

USGS 302716091083801 EB- 751
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
60
80
100
120
140
160
180
200
-20
-40
-60
-80
-100
-120
-140
1964
1970
1976
1982
1988
1994
2000
2006

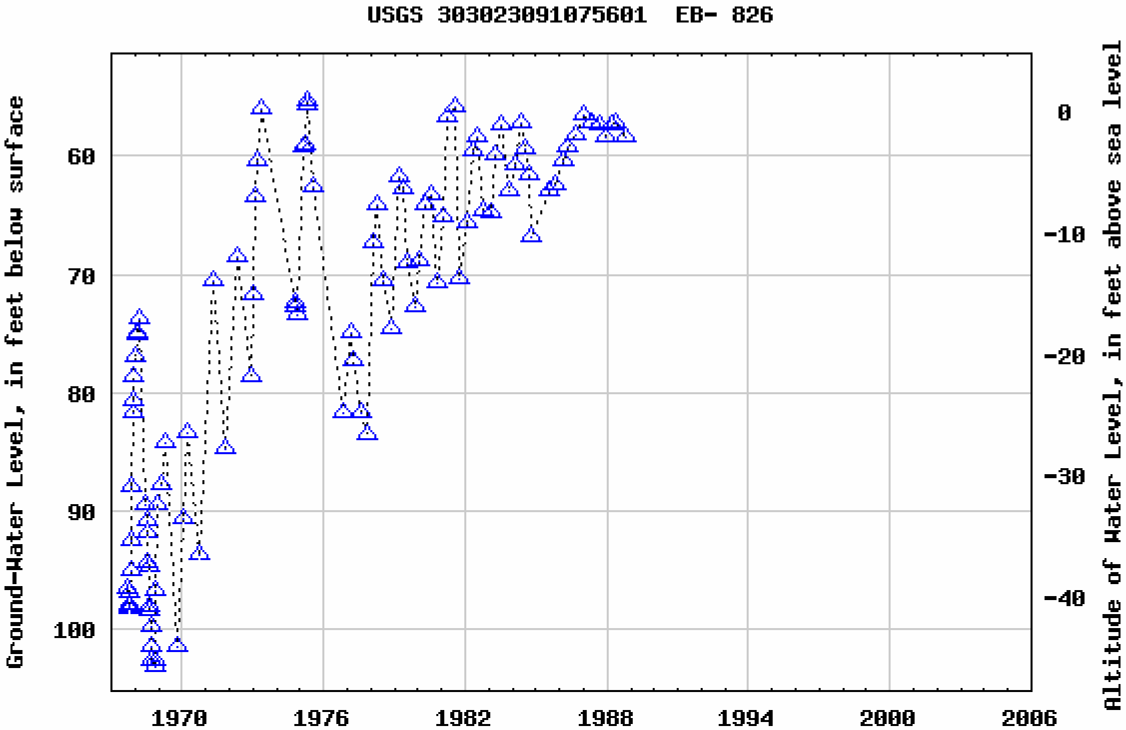

USGS 303019091073701 EB- 756
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
105.0
106.0
107.0
108.0
109.0
110.0
111.0
112.0
113.0
-48.0
-49.0
-50.0
-51.0
-52.0
-53.0
-54.0
-55.0
-56.0
1964
1970
1976
1982
1988
1994
2000
2006

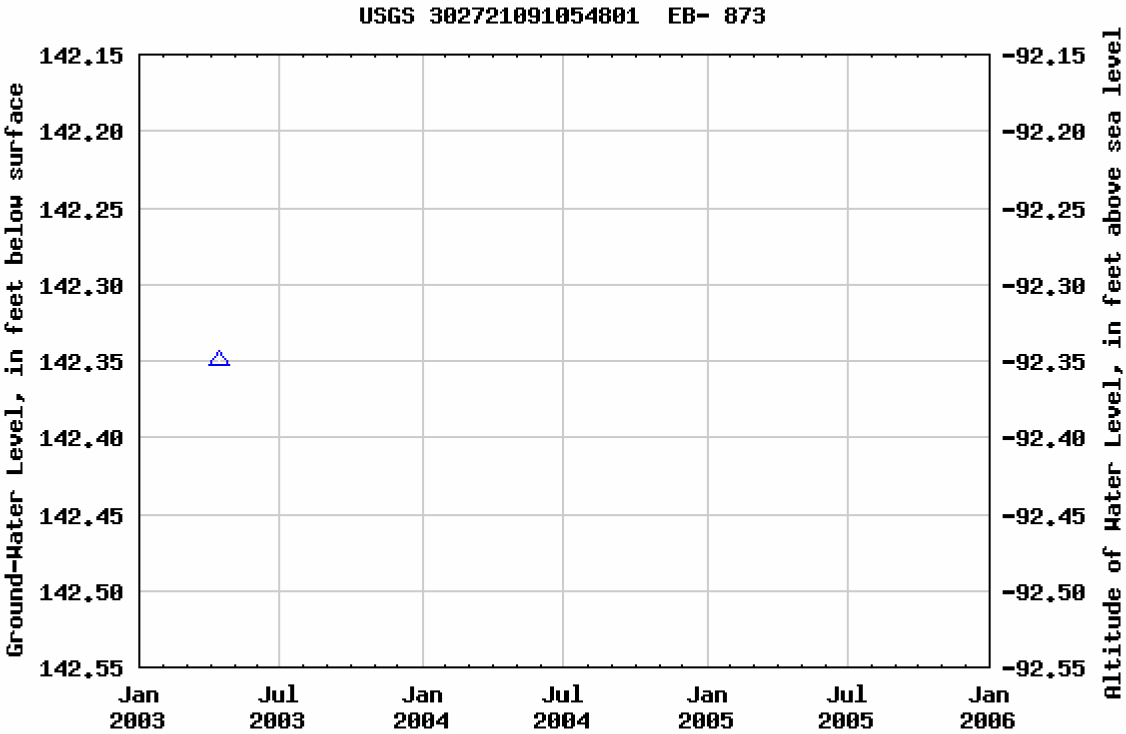

USGS 303021091073701 EB- 769
Ground-Water Level, in feet below surface
100
120
140
160
180
1964
1970
1976
1982
1988
1994
2000
2006
Altitude of Water Level, in feet above sea level
-40
-60
-80
-100
-120

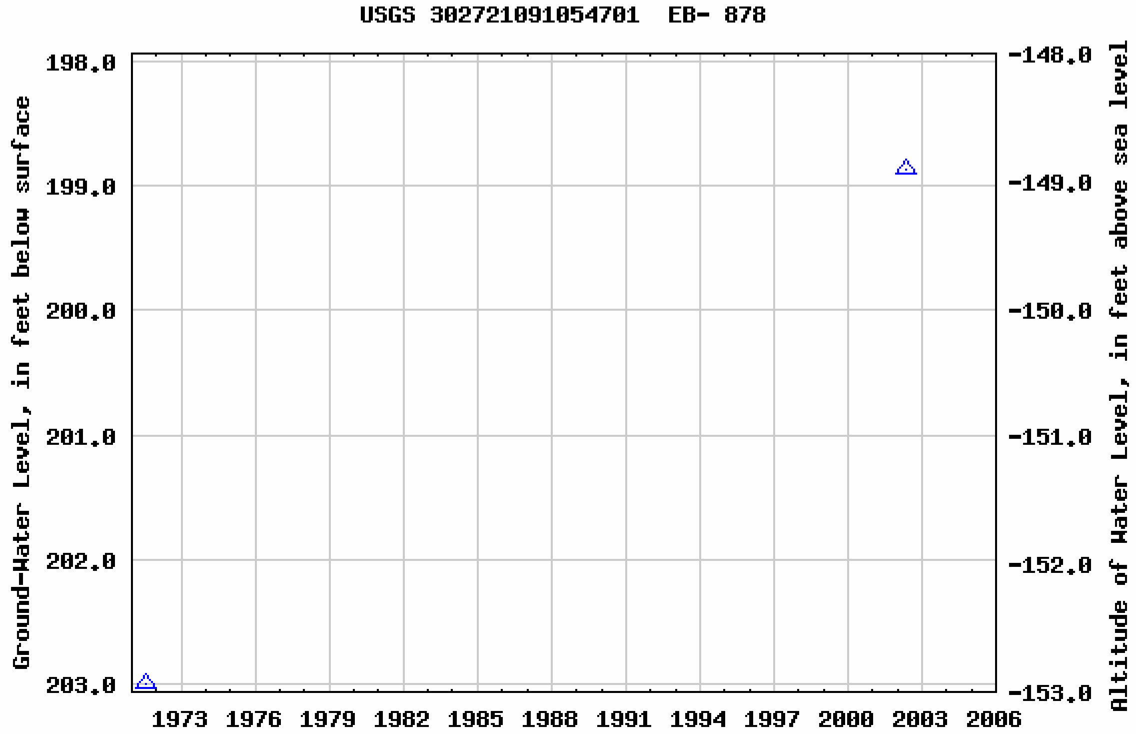

USGS 302718091083901 EB- 774
Ground-Water Level, in feet below surface
50
100
150
200
250
1964
1970
1976
1982
1988
1994
2000
2006
Altitude of Water Level, in feet above sea level
-50
-100
-150
-200

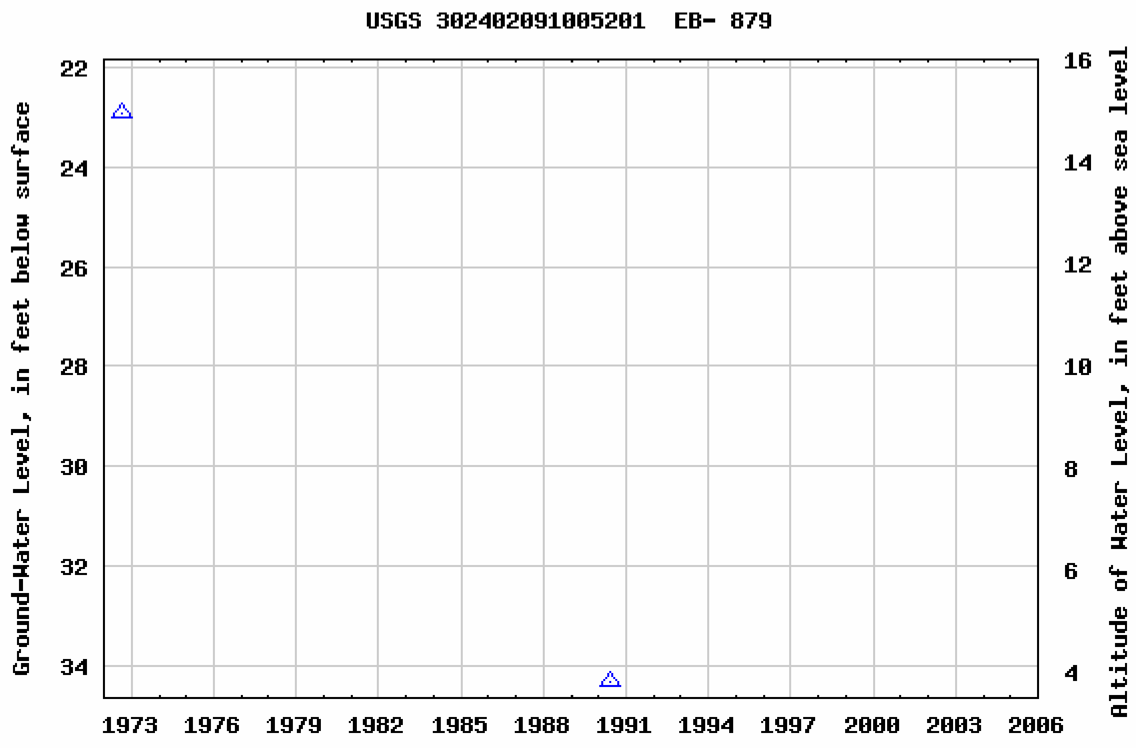

USGS 303135091070502 EB- 779
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
61.80
61.85
61.90
61.95
62.00
62.05
62.10
62.15
62.20
-1.80
-1.85
-1.90
-1.95
-2.00
-2.05
-2.10
-2.15
-2.20
1970
1976
1982
1988
1994
2000
2006

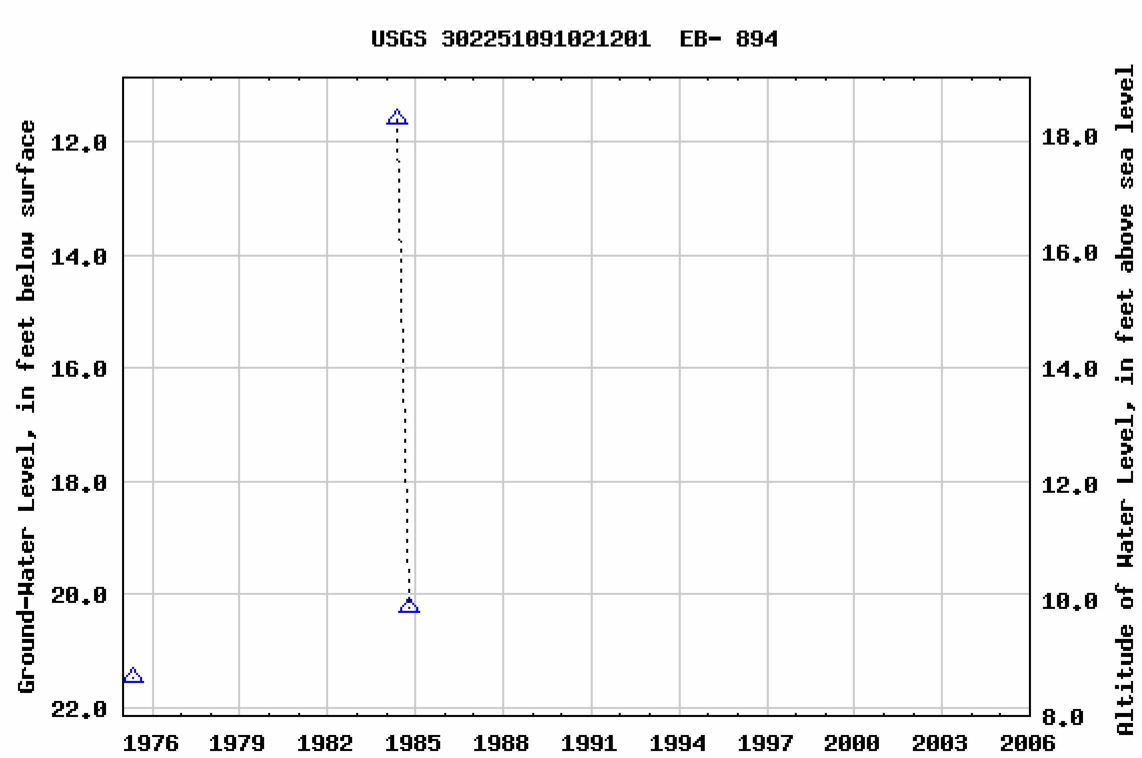

USGS 302428091035002 EB- 804B
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
40
60
80
100
120
20
0
-20
-40
-60
-80
1970
1976
1982
1988
1994
2000
2006

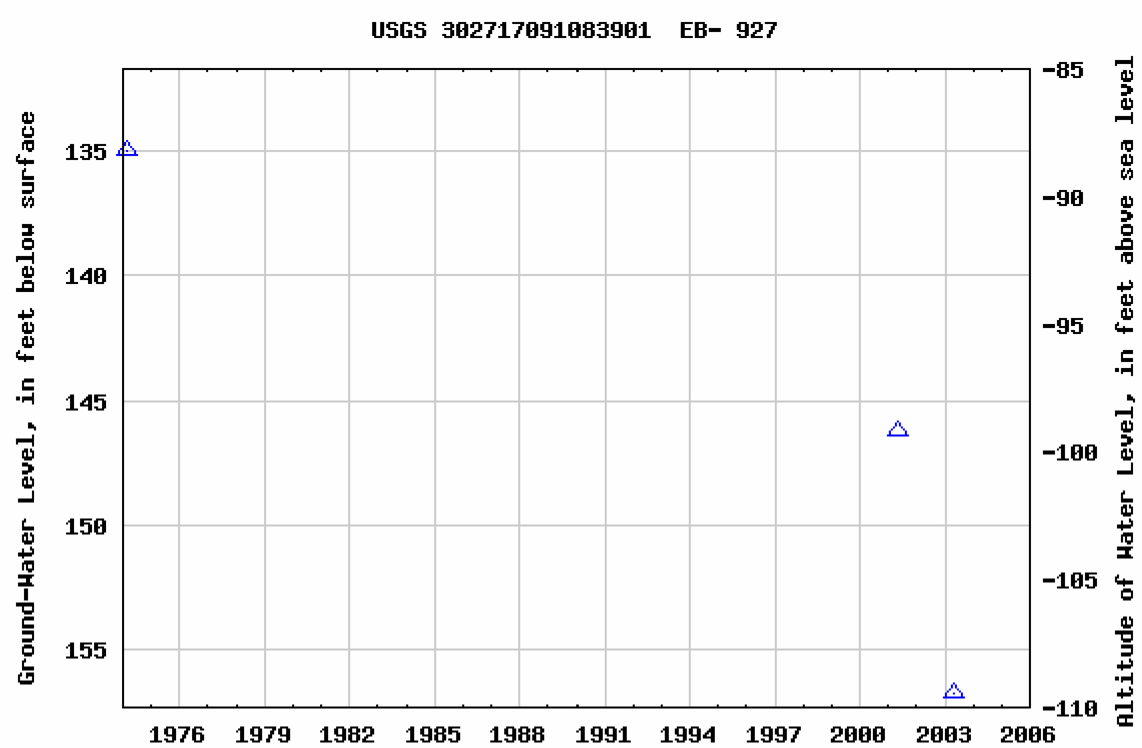

USGS 303023091075601 EB- 826
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
60
70
80
90
100
0
-10
-20
-30
-40
1970
1976
1982
1988
1994
2000
2006

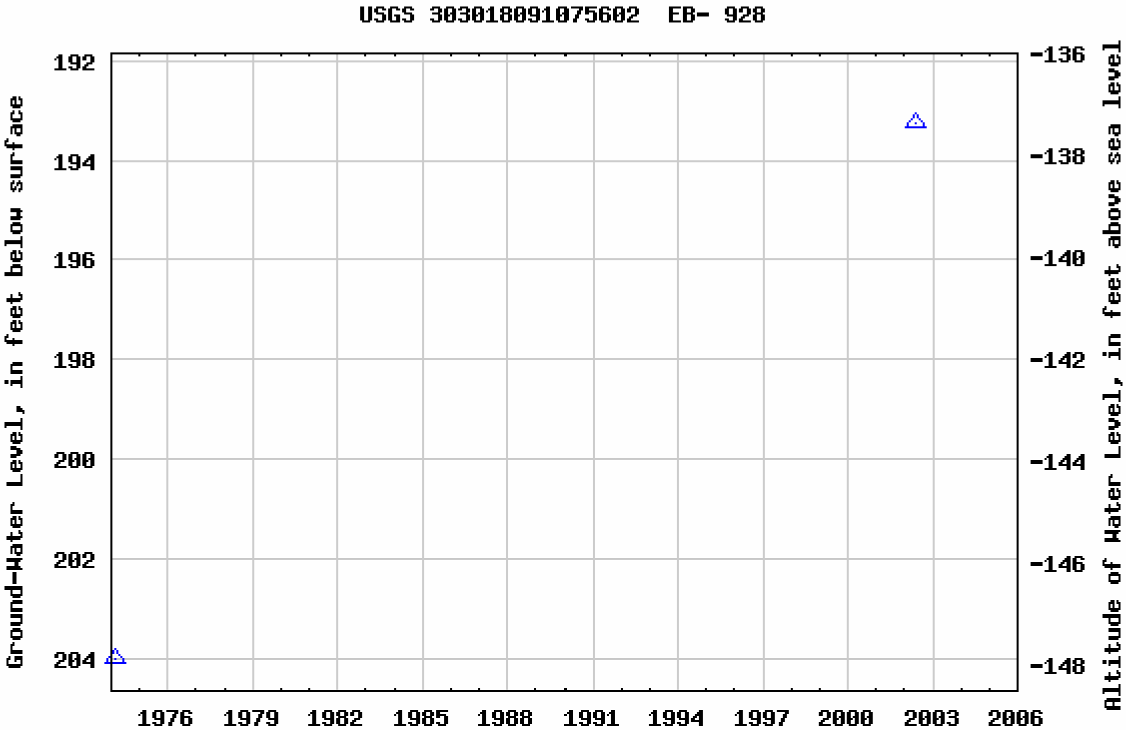

USGS 302721091054801 EB- 873
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
142.15
142.20
142.25
142.30
142.35
142.40
142.45
142.50
142.55
-92.15
-92.20
-92.25
-92.30
-92.35
-92.40
-92.45
-92.50
-92.55
Jan 2003
Jul 2003
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006


USGS 302721091054701 EB- 878
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
198.0
199.0
200.0
201.0
202.0
203.0
-148.0
-149.0
-150.0
-151.0
-152.0
-153.0
1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006

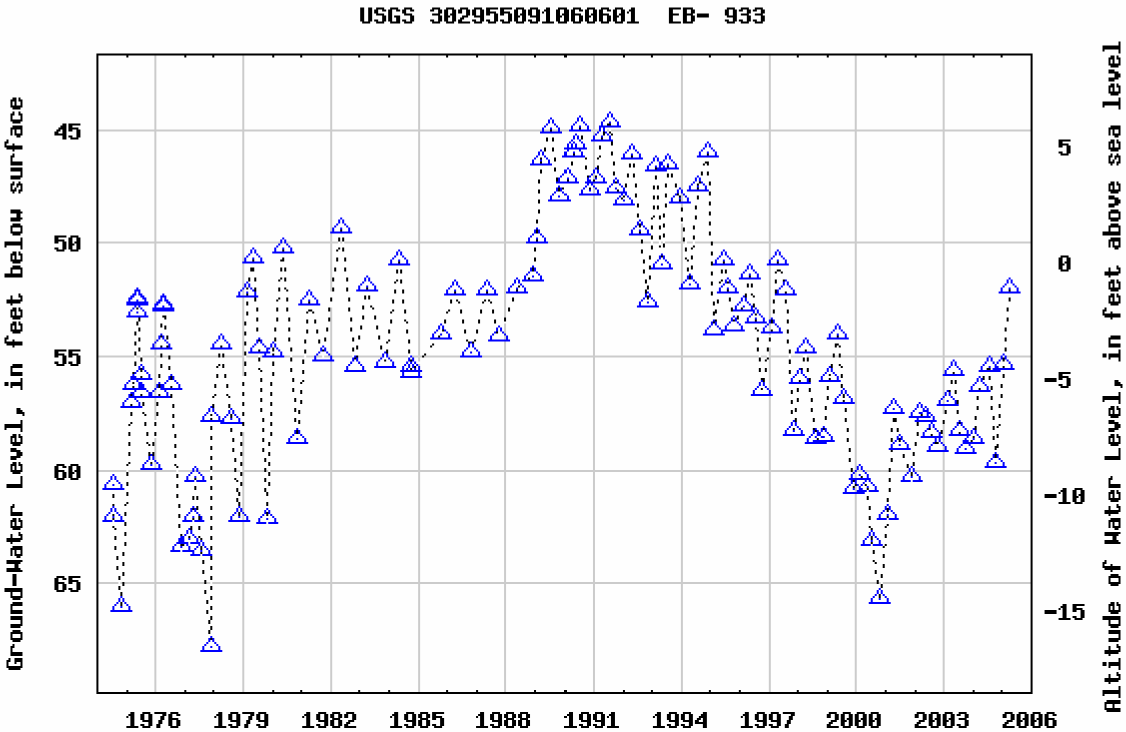

USGS 302402091005201 EB- 879
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
22
24
26
28
30
32
34
16
14
12
10
8
6
4
1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006


USGS 302251091021201 EB- 894
Ground-Water Level, in feet below surface
12.0
14.0
16.0
18.0
20.0
22.0
Altitude of Water Level, in feet above sea level
18.0
16.0
14.0
12.0
10.0
8.0
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

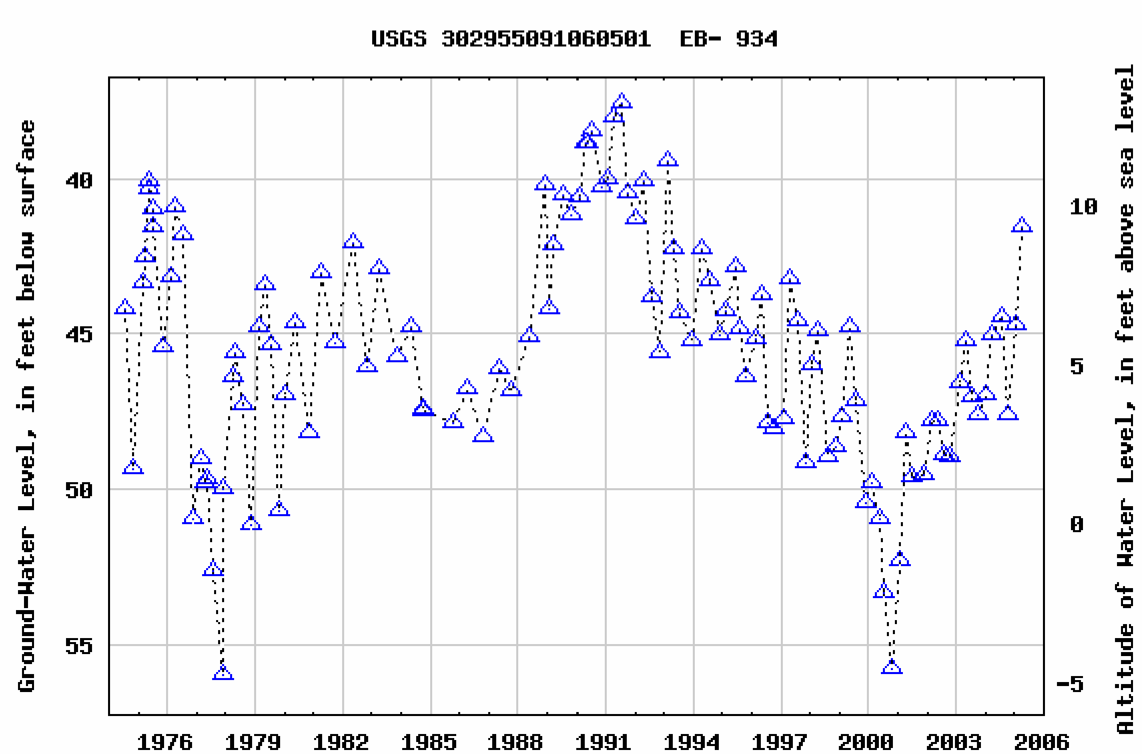

USGS 302717091083901 EB- 927
Ground-Water Level, in feet below surface
135
140
145
150
155
Altitude of Water Level, in feet above sea level
-85
-90
-95
-100
-105
-110
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

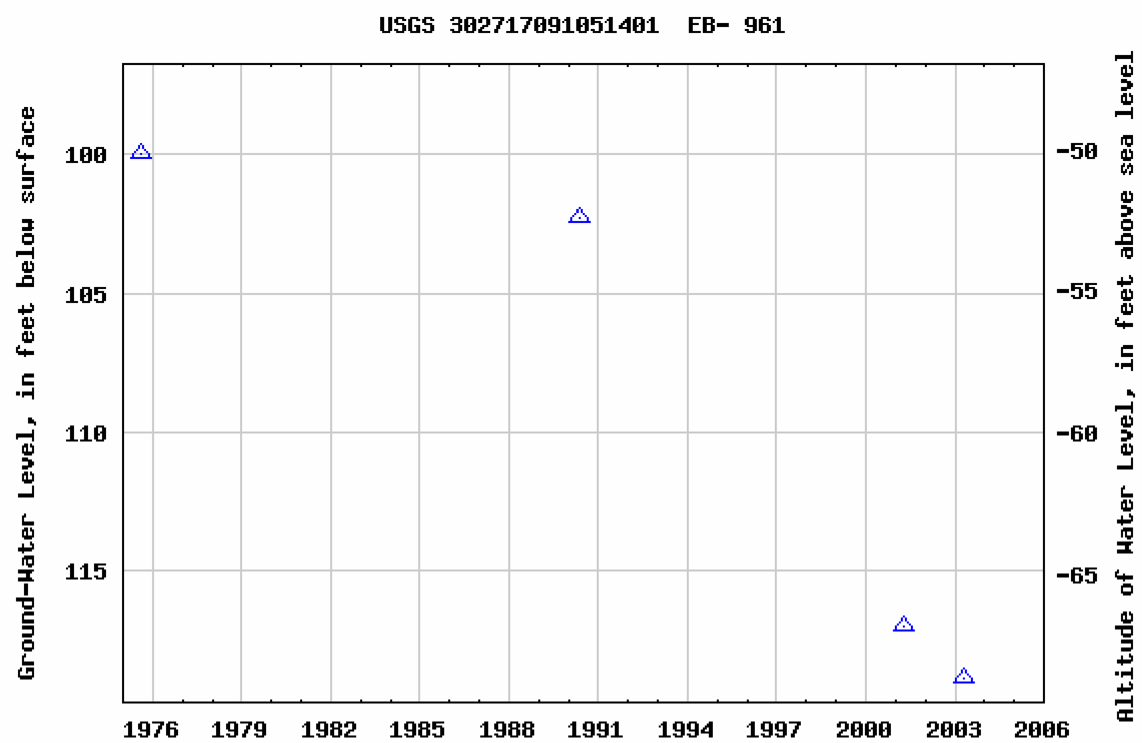


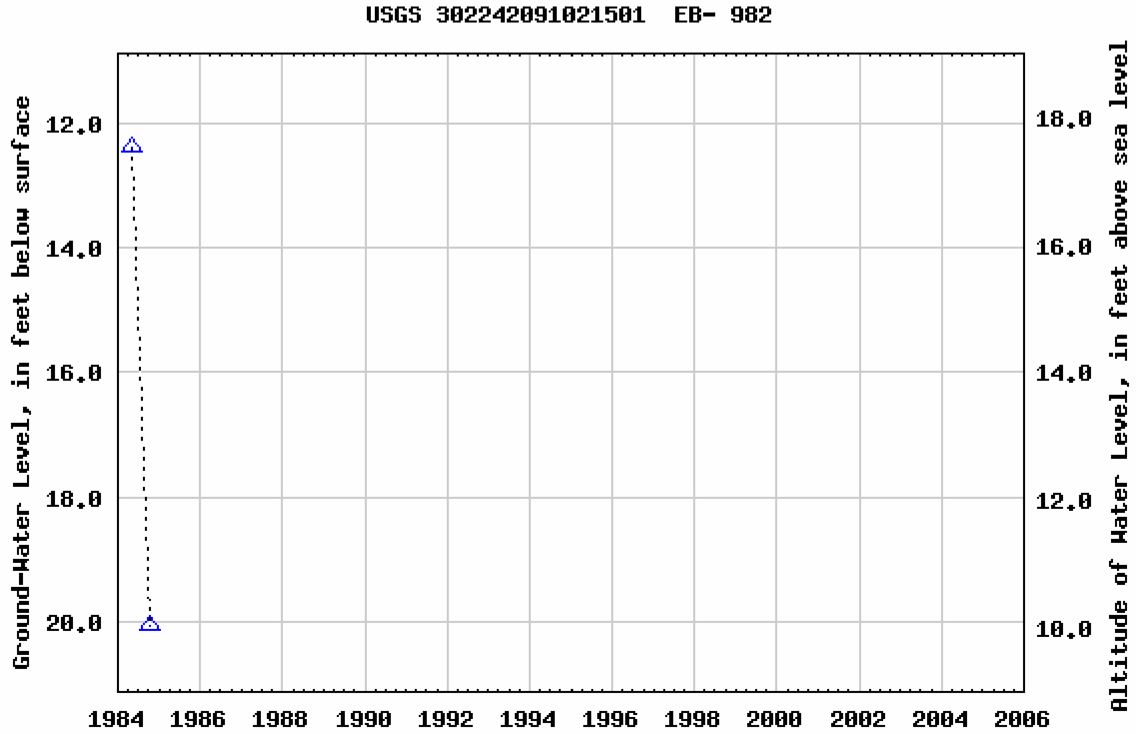
USGS 303018091075602 EB- 928
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
192
194
196
198
200
202
204
-136
-138
-140
-142
-144
-146
-148
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

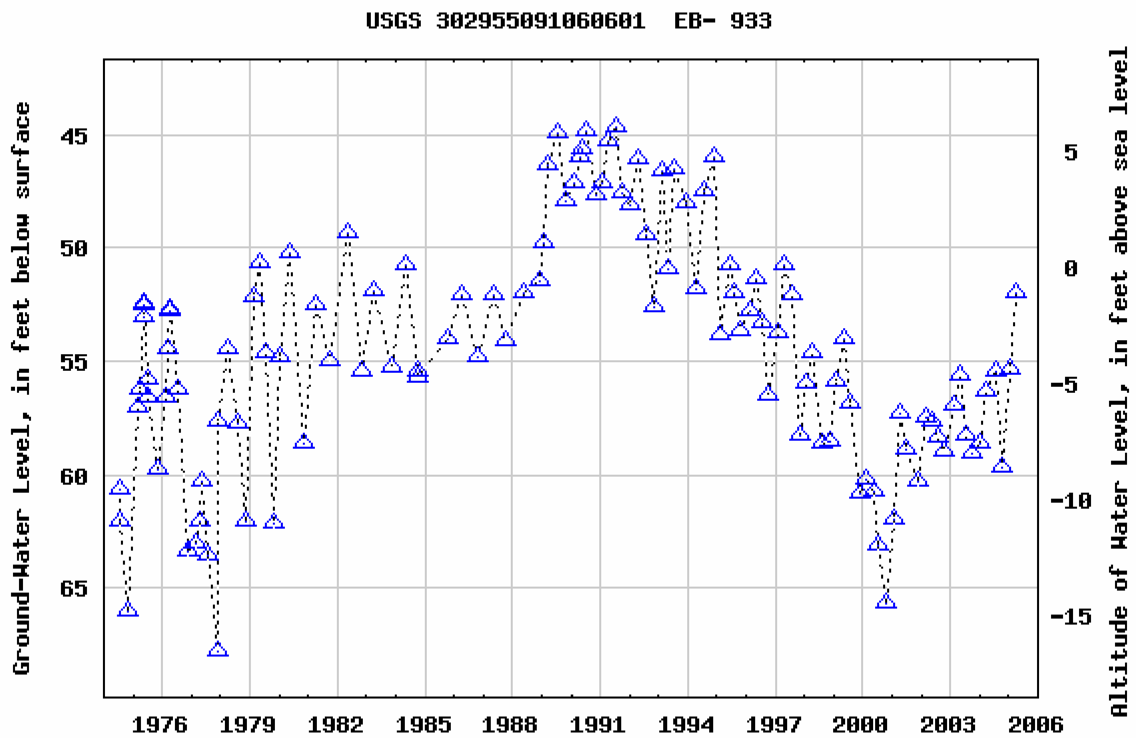


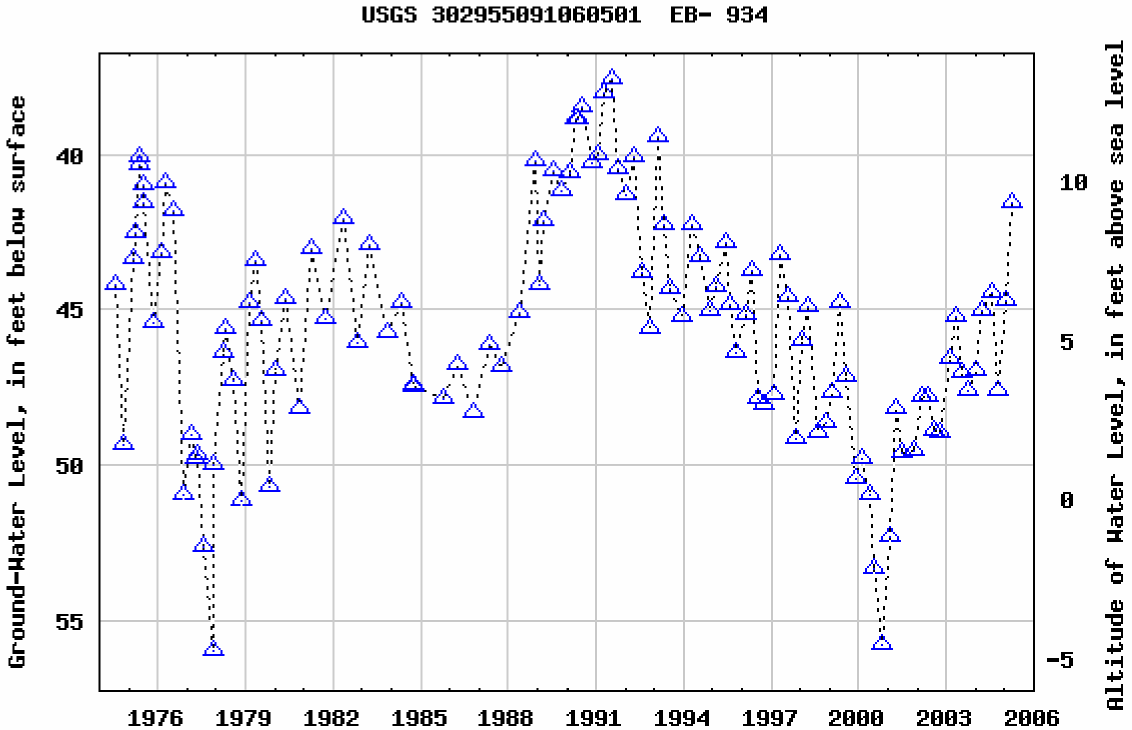
USGS 302955091060601 EB- 933
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
45
50
55
60
65
5
0
-5
-10
-15
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

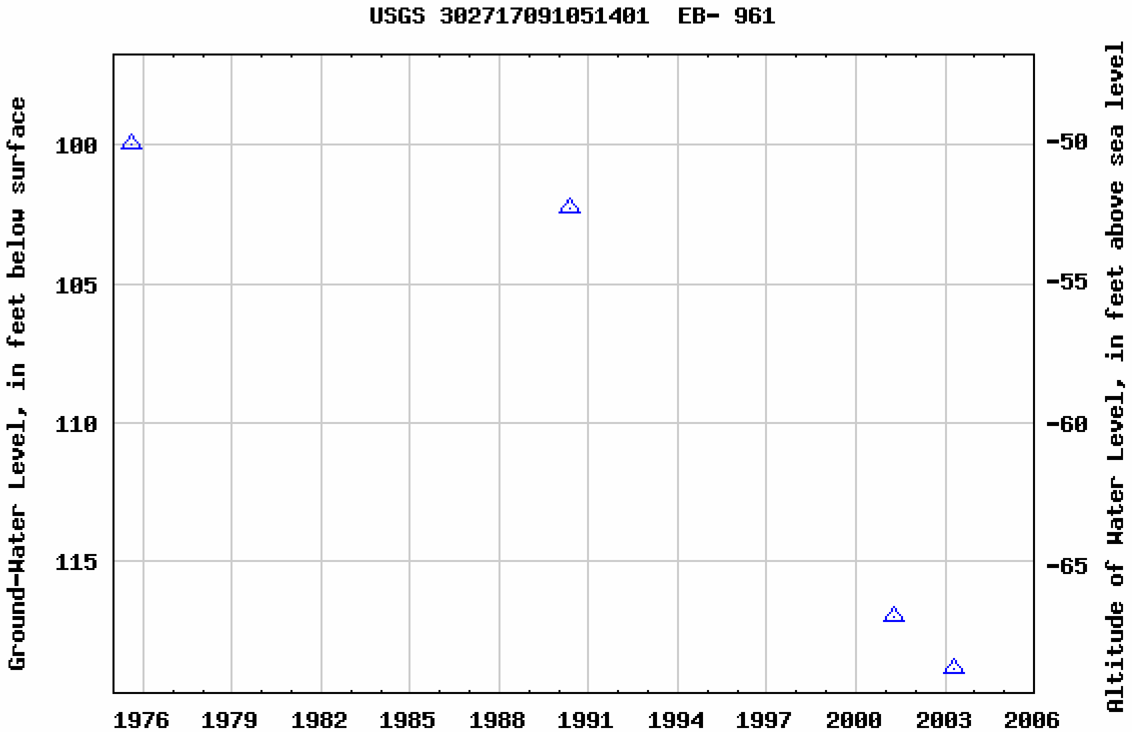

USGS 302955091060501 EB- 934
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
40
45
50
55
10
5
0
-5
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

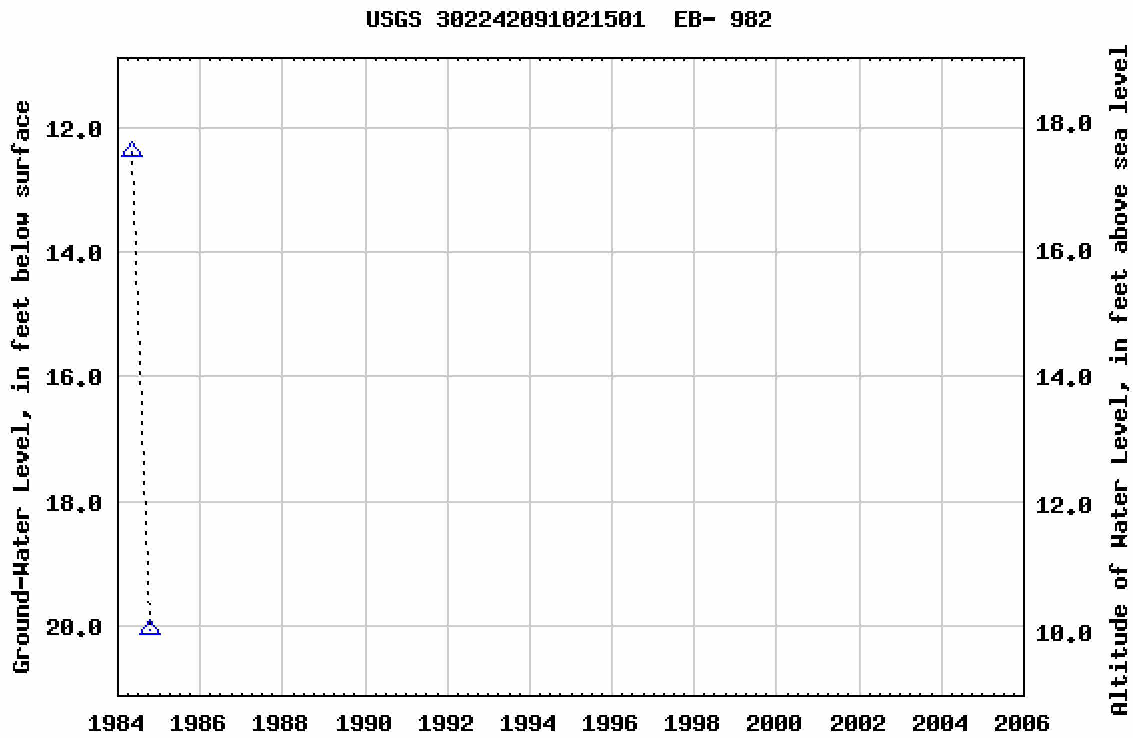

USGS 302717091051401 EB- 961
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
100
105
110
115
-50
-55
-60
-65
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

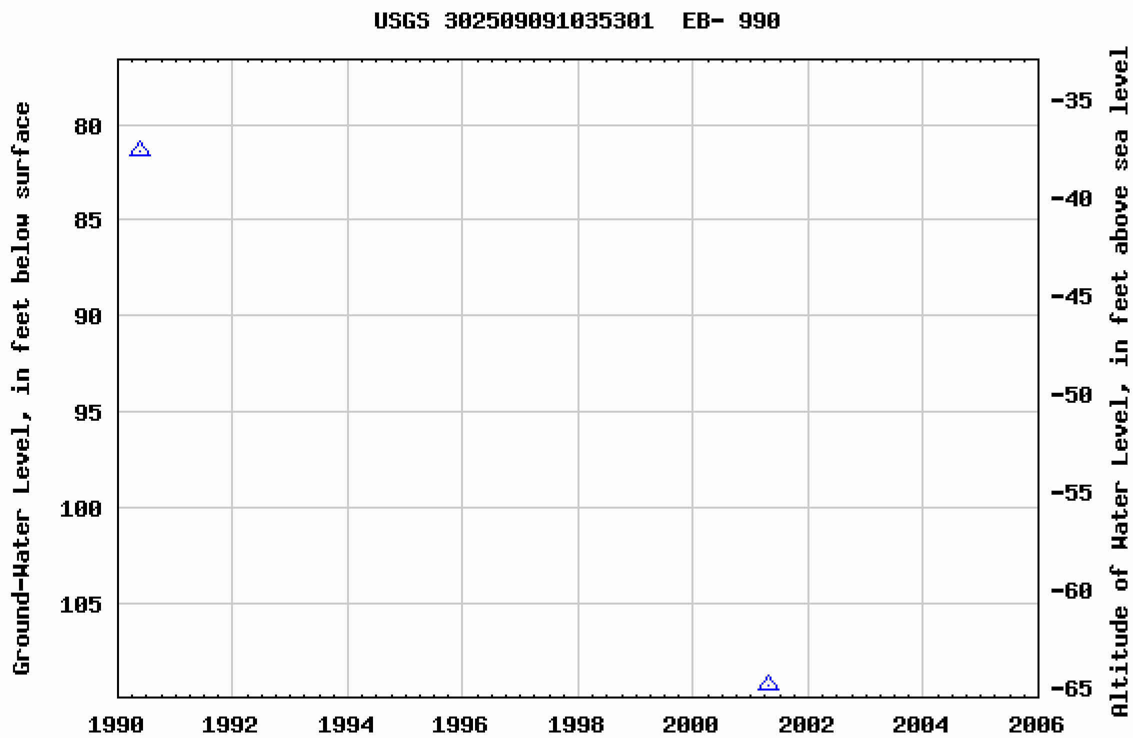

USGS 302242091021501 EB- 982
Ground-Water Level, in feet below surface
12.0
14.0
16.0
18.0
20.0
Altitude of Water Level, in feet above sea level
18.0
16.0
14.0
12.0
10.0
1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006

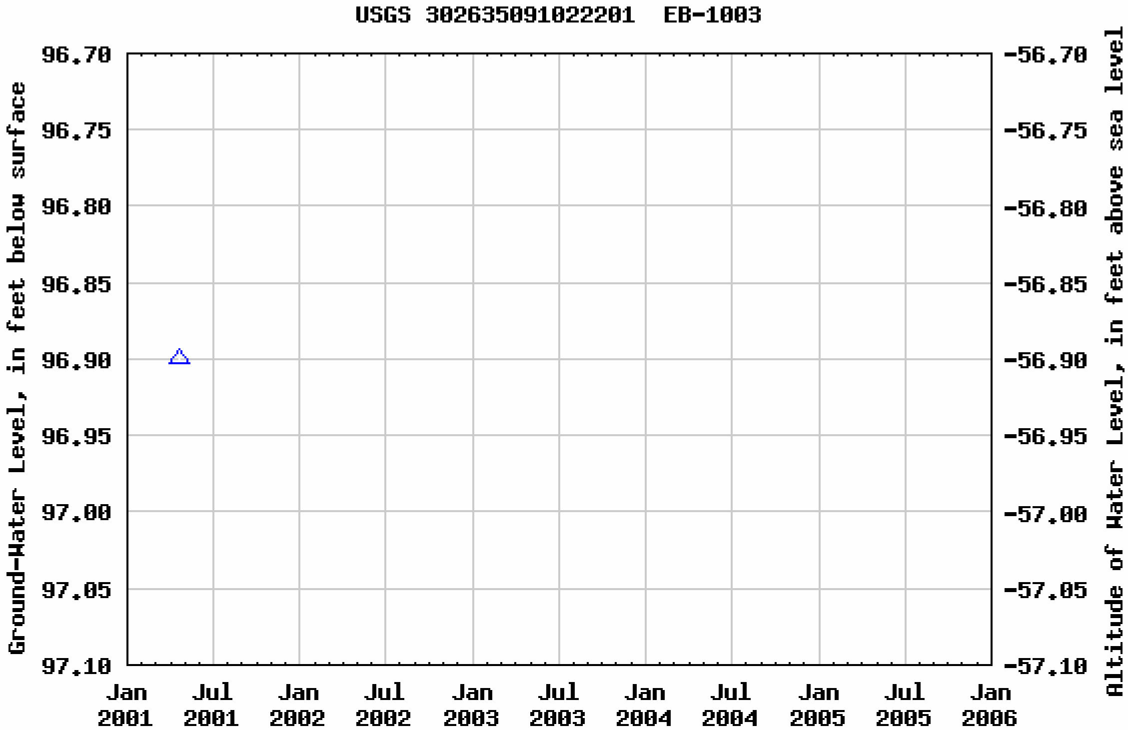

USGS 302955091060601 EB- 933
Ground-Water Level, in feet below surface
45
50
55
60
65
Altitude of Water Level, in feet above sea level
5
0
-5
-10
-15
1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006

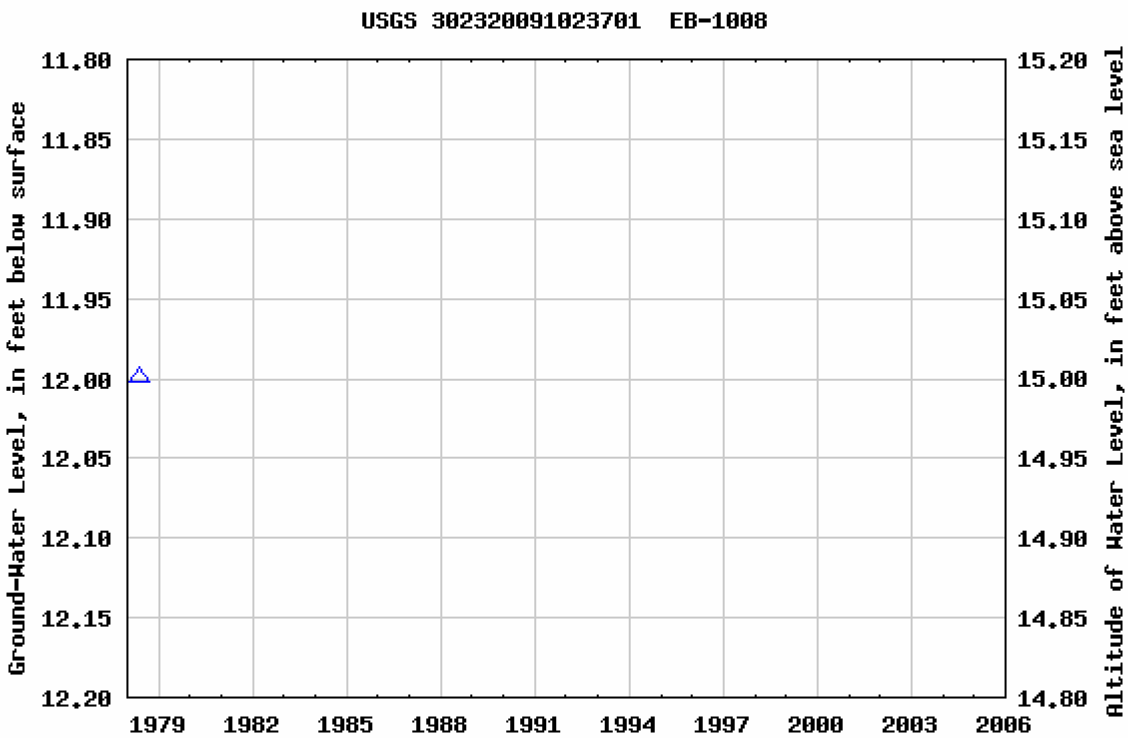

USGS 302955091060501 EB- 934
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
40
45
50
55
10
5
0
-5
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

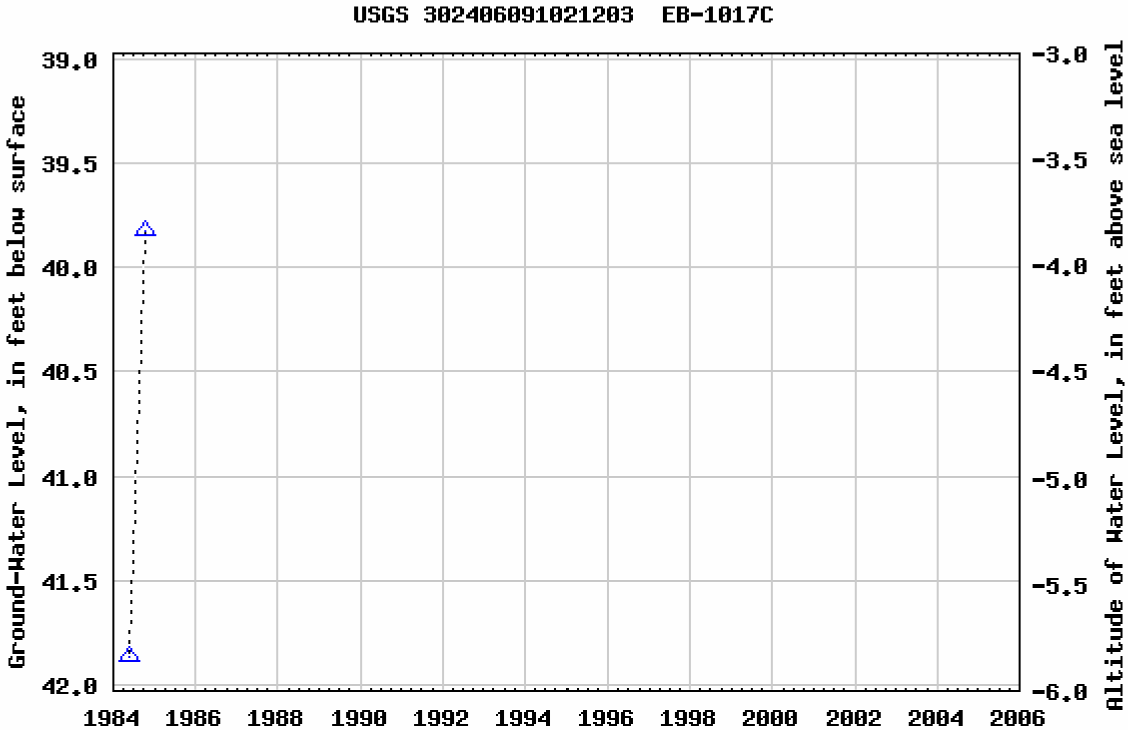

USGS 302717091051401 EB- 961
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
100
105
110
115
-50
-55
-60
-65
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

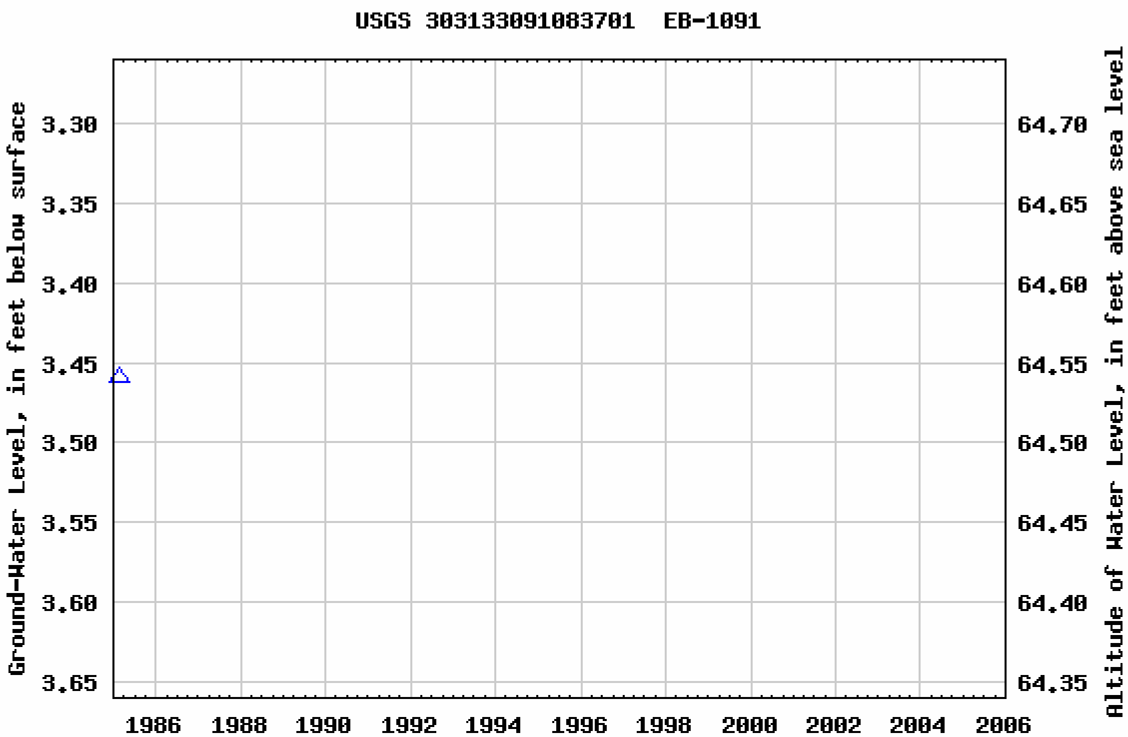

USGS 302242091021501 EB- 982
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
12.0
14.0
16.0
18.0
20.0
18.0
16.0
14.0
12.0
10.0
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006

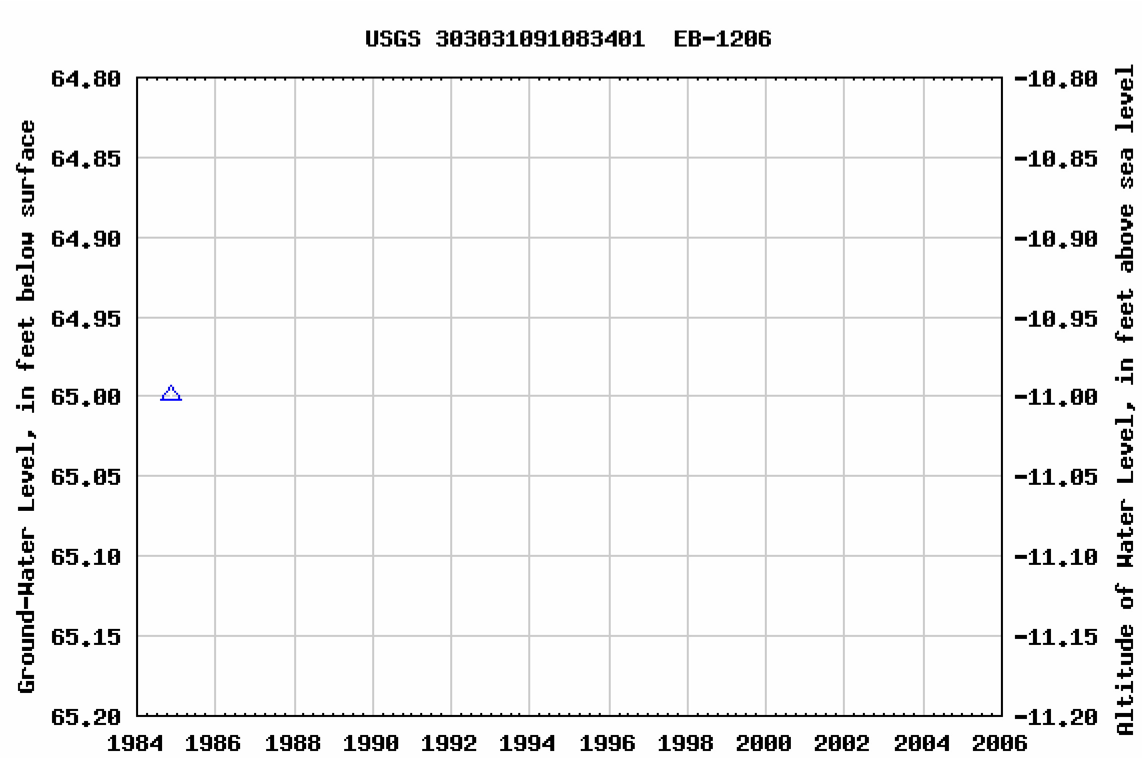

USGS 302509091035301 EB- 990
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
80
85
90
95
100
105
-35
-40
-45
-50
-55
-60
-65
1990
1992
1994
1996
1998
2000
2002
2004
2006

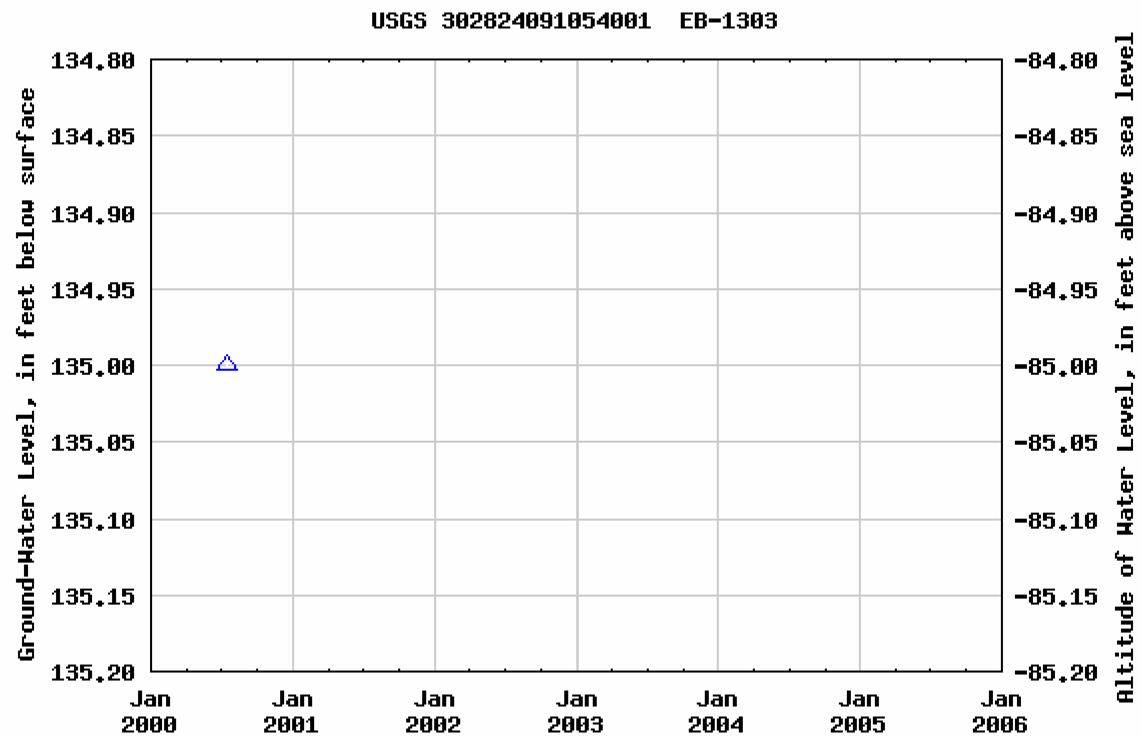

USGS 302635091022201 EB-1003
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
96.70
96.75
96.80
96.85
96.90
96.95
97.00
97.05
97.10
-56.70
-56.75
-56.80
-56.85
-56.90
-56.95
-57.00
-57.05
-57.10
Jan 2001
Jul 2001
Jan 2002
Jul 2002
Jan 2003
Jul 2003
Jan 2004
Jul 2004
Jan 2005
Jul 2005
Jan 2006


USGS 302320091023701 EB-1008
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
11.80
11.85
11.90
11.95
12.00
12.05
12.10
12.15
12.20
15.20
15.15
15.10
15.05
15.00
14.95
14.90
14.85
14.80
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006


USGS 302406091021203 EB-1017C
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
39.0
39.5
40.0
40.5
41.0
41.5
42.0
-3.0
-3.5
-4.0
-4.5
-5.0
-5.5
-6.0
1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006


USGS 303133091083701 EB-1091
Ground-Water Level, in feet below surface
Altitude of Water Level, in feet above sea level
3.30
3.35
3.40
3.45
3.50
3.55
3.60
3.65
64.70
64.65
64.60
64.55
64.50
64.45
64.40
64.35
1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006





Note: Hydrographs for EB-198C, EB- 227, EB-373 and EB-443 were unable to be obtained from the USGS 'Groundwater Levels for the Nation' website, http://nwis.waterdata.usgs.gov/nwis.

APPENDIX I DEPTH CONVERSIONS FOR FIELD STUDY AREAS

DEPTH CONVERSIONS OF FIELD STUDY AREAS BASED ON DIFFERENT VELOCITIES				
Velocities (m/ns)	**TWTT of WDLWN Reflectors observed (ns)**	**Depth of penetration (m) WDLWN**	**TWTT of Glen Oaks Reflectors Observed (ns)**	**Depth of penetration (m) Glen Oaks**
0.06	14.4	0.432	16	0.48
0.07		0.504		0.56
0.1		0.72		0.8
0.15		1.08		1.2
0.06	16	0.48	28.6	0.858
0.07		0.56		1.001
0.1		0.8		1.43
0.15		1.2		2.145
0.06	28.5	0.855	80	2.4
0.07		0.9975		2.8
0.1		1.425		4
0.15		2.1375		15
0.06	40	1.2	112	3.36
0.07		1.4		3.92
0.1		2		5.6
0.15		3		8.4
0.06	48	1.44	114.4	3.432
0.07		1.68		4.004
0.1		2.4		5.72
0.15		3.6		8.58
0.06	54.8	1.644	128.7	3.861
0.07		1.918		4.5045
0.1		2.74		6.435
0.15		4.11		9.6525
0.06	57.2	1.716	143	4.29
0.07		2.002		5.005
0.1		2.86		7.15
0.15		4.29		10.725
0.06	64	1.92	160	4.8
0.07		2.24		5.6
0.1		3.2		8
0.15		4.8		12
0.06	80	2.4	178.8	5.364
0.07		2.8		6.258
0.1		4		8.94
0.15		6		13.41
0.06	85.5	2.565	180	5.4

Velocities (m/ns)	TWTT of WDLWN Reflectors observed (ns)	Depth of penetration (m) WDLWN	TWTT of Glen Oaks Reflectors Observed (ns)	Depth of penetration (m) Glen Oaks
0.07	85.5	2.9925	180	6.3
0.1		4.275		9
0.15		6.4125		13.5
0.06	96	2.88	201.2	6.036
0.07		3.36		7.042
0.1		4.8		10.06
0.15		7.2		15.09
0.06	109.4	6.564	256	7.68
0.07		7.658		8.96
0.1		10.940		12.8
0.15		16.410		19.2
0.06	112	3.360	322	9.66
0.07		3.920		11.27
0.1		5.600	322	16.10
0.15		8.400		24.15
0.06	114.4	3.4		
0.07		4.0		
0.1		5.7		
0.15		8.6		
0.06	121.2	3.64		
0.07		4.24		
0.1		6.06		
0.15		9.09		
0.06	128	3.84		
0.07		4.48		
0.1		6.40		
0.15		9.60		
0.06	128.8	3.86		
0.07		4.51		
0.1		6.44		
0.15		9.66		
0.06	162.5	4.875		
0.07		5.688		
0.1		8.125		
0.15		12.188		
0.06	166.2	4.99		
0.07		5.82		
0.1		8.31		
0.15		12.47		

Velocities (m/ns)	TWTT of WDLWN Reflectors observed (ns)	Depth of penetration (m) WDLWN	TWTT of Glen Oaks Reflectors Observed (ns)	Depth of penetration (m) Glen Oaks
0.06	171.6	5.1		
0.07		6.0		
0.1		8.6		
0.15		12.9		
0.06	175	5.250		
0.07		6.125		
0.1		8.750		
0.15		13.125		
0.06	180.4	5.41		
0.07		6.31		
0.1		9.02		
0.15		13.53		
0.06	209.4	6.282		
0.07		7.329		
0.1		10.470		
0.15		15.705		
0.06	218.8	6.564		
0.07		7.658		
0.1		10.940		
0.15		16.410		
0.06	266	7.98		
0.07		9.31		
0.1		13.30		
0.15		19.95		
0.06	304	9.12		
0.07		10.64		
0.1		15.20		
0.15		22.80		
0.06	467.8	14.034		
0.07		16.373		
0.1		23.390		
0.15		35.085		

APPENDIX J GPR RESULTS FOR REMAINING FORMER WOODLAWN HIGH SCHOOL TRANSECTS

J.1 Transect WOOD2_L1

Transect WOOD2_L1 is parallel to the west Band Room Wall, and between transects WOOD2_8 and WOODNEW (Figure 6.10). The reflections shown in the Ekko_View imaging program for this transect appear to be received from ground surface to a TWTT of 96 ns, or a depth of 4.8 m, using a velocity of 0.1 m/ns, the depth would be between 2.88 m and 3.36 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure J.1 is a Wiggle Trace view of the raw WOOD2_L1 transect data which shows the shallow reflectors to be relatively horizontal; however, five shallow offsets are observed. Of these shallow offsets, one is dipping towards the south and the remaining four are dipping towards the north. Figure J.2 is the same transect WOOD2_L1, but is a processed Wiggle Trace view which shows a bowl shaped feature and eight bedding offsets, four dipping towards the south and four dipping towards the north.

There are five faint offsets in bedding observed in the raw data at shallow depths, and at horizontal distances of 8.7 m, 10.7 m, 11.7 m, 13.2 m and 16.7 m in Figure J.1 in purple pink, yellow, orange, royal blue and cream respectively. As in the previous transects, a bowl shaped feature is observed spanning the entire length of the transect and is marked in Figure J.2 in red. There are six more shallow offsets observed in the processed data that are not seen in the raw data, five are located north and two are between the offsets observed in the raw data. The additional shallow offsets are located at horizontal distances of 1.7 m, 3 m, 4.7 m, 7 m, 16 m and 18.7 m, and are outlined in Figure J.2 in light pink, purple, blue, green, olive and brown respectively.

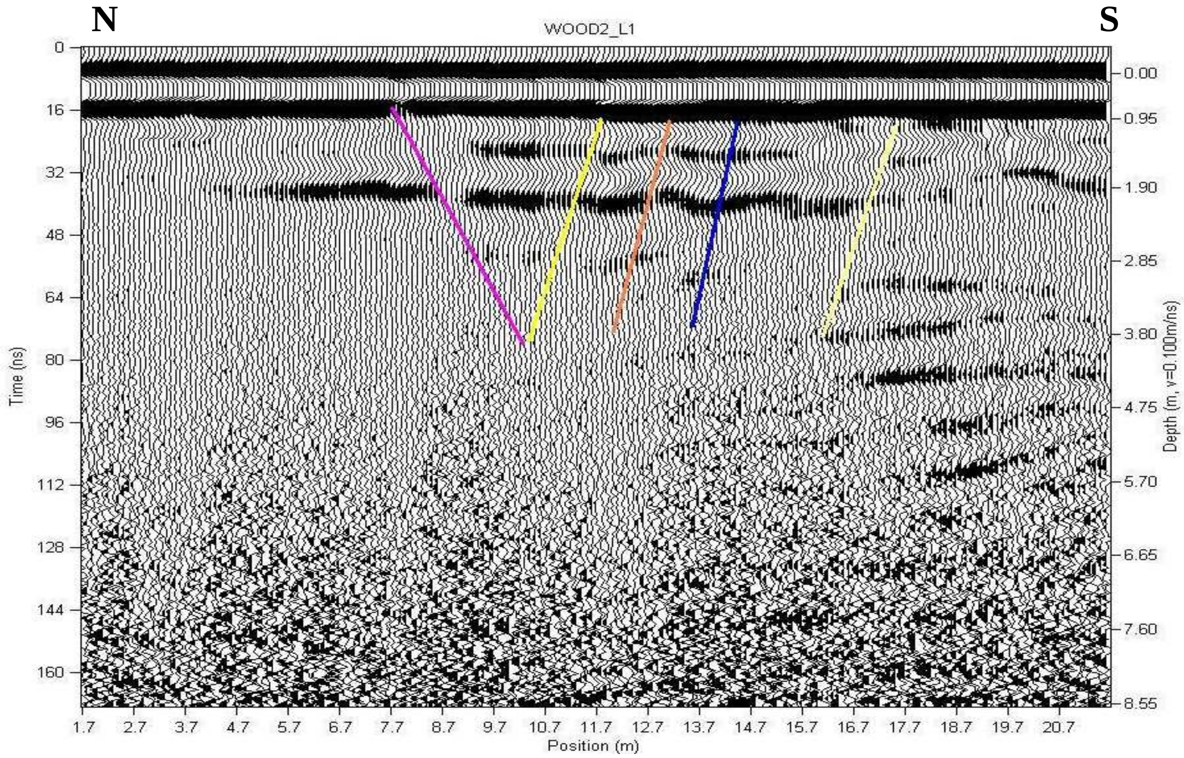


Figure J.1. WOOD2_L1 Raw Data. The purple pink, yellow, orange, royal blue and cream lines denote offsets of beds.

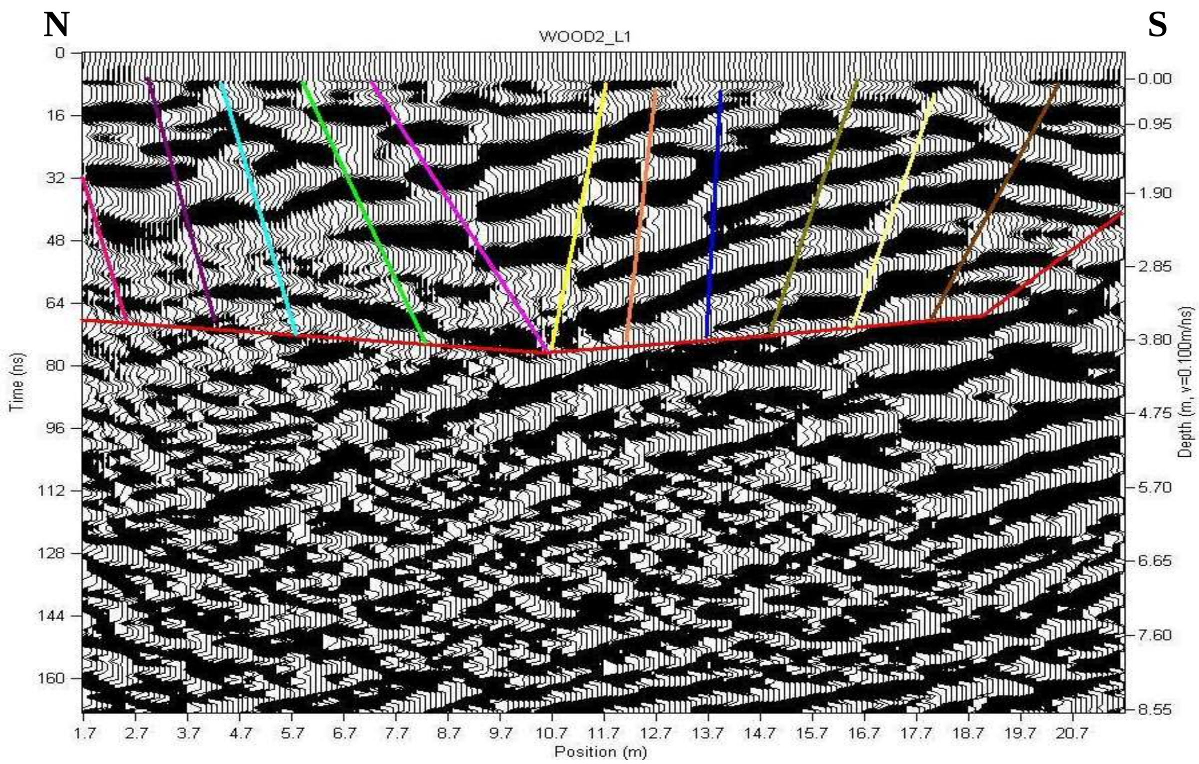


Figure J.2. WOOD2_L1 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green, yellow, orange, royal blue, olive, cream and brown lines denote offsets of beds.

J.2 Transect WOODNEW2

Transect WOODNEW2 is parallel to the west Band Room Wall, and between transects WOODNEW and WOOD3_8. The reflections shown in the Ekko_View imaging program for this transect are very similar to the WOODNEW transect, there are just some slight variations on locations of similar offsets or crossovers and some smoothing of the data. The reflections observed were received from ground surface to a TWTT of 209.4 ns, or a depth of 10.47 m, using a velocity of 0.1 m/ns, the depth would be between 6.28 m and 7.33 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure J.3 is a Wiggle Trace view of the raw WOODNEW2 transect data which show reflectors from ground surface to approximately 10.47 m. Figure J.4 is the same transect WOODNEW2, but is a processed Wiggle Trace view which shows several reflected features and one distinct crossover.

In WOODNEW2 there are seven faint offsets in bedding observed at shallow depths in the raw data from ground surface to a maximum TWTT of 128.8 ns or a depth of 6.44 m. Each of these offsets are located at horizontal distances of 1.5 m, 3 m, 6 m, 6.5 m, 7.5 m, 9.5 m and 18 m and are outlined in Figure J.3 in light pink, purple, blue, green, purple pink, yellow and cream respectively. As in previous transects, once processed, a bowl shaped feature is observed spanning the entire length of the transect and is marked in Figure J.4 in red. There are three more shallow offsets observed in the processed data that are not seen in the raw data, these transects are located between previously observed offsets in the raw data. The additional shallow offsets are located at horizontal distances of 11.5 m, 13.5 m, 15.5 m and 17.5 m and are outlined in Figure J.4 in orange, royal blue and olive respectively.

There are also some cross over features that appear at deeper depths that the geologic reflectors discussed previously, which are an artifact that is not a result of soil geology.

These crossovers are observed at horizontal distances of 7 m and 14 m and are outlined by a bright orange 'X' in Figure J.5. Again according to literature, one suggestion to remove an affect such as the crossover is to migrate the data using the air wave velocity, 0.3 m/ns. Figure J.5 shows the WOODNEW transect processed with both 0.1 m/ns and 0.3 m/ns velocities. With the use of the additional 2-D Migration, the cross over features appear to be removed; however the bulk of the data appears to be over migrated and appears to be concave upwards due to the use of an incorrect velocity.

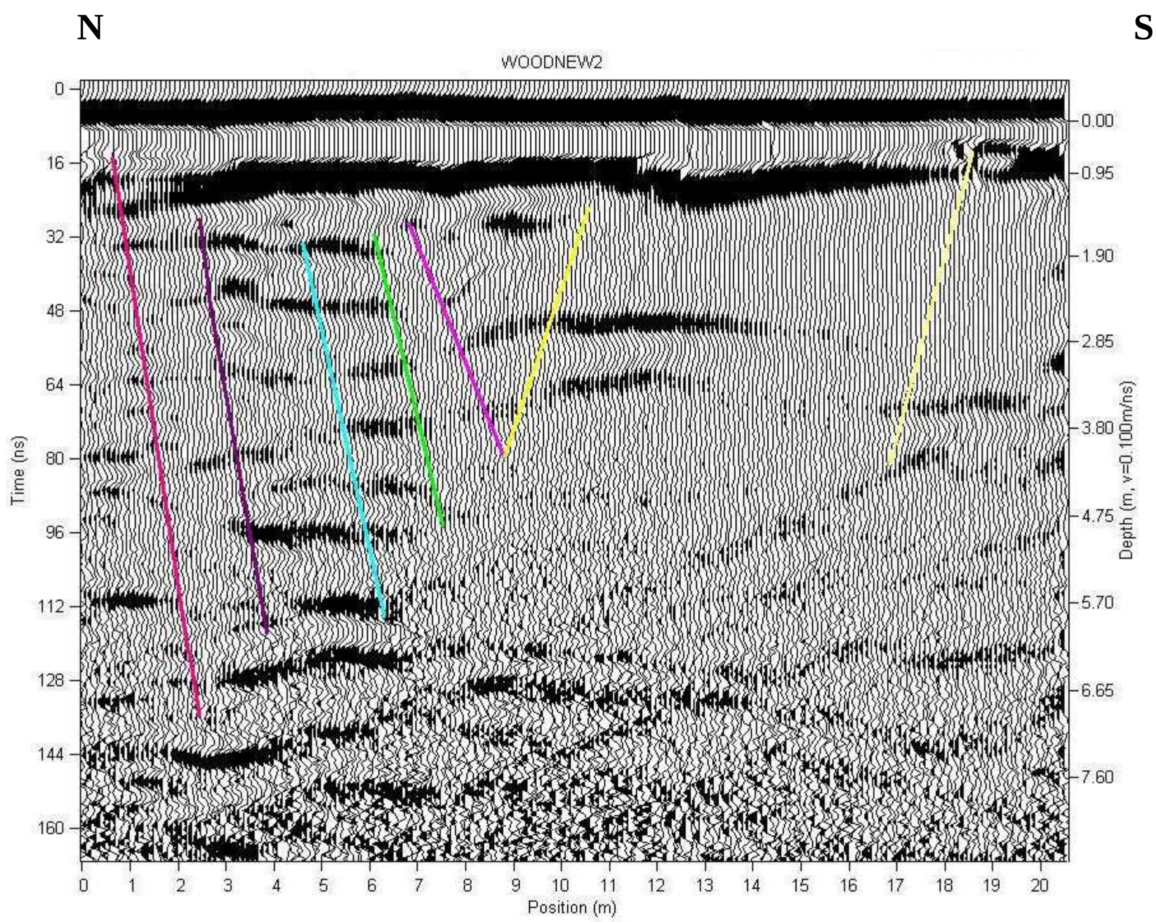


Figure J.3. WOODNEW2 Raw Data. The two pinks, purple, blue, green, yellow and cream lines denote offsets of beds.

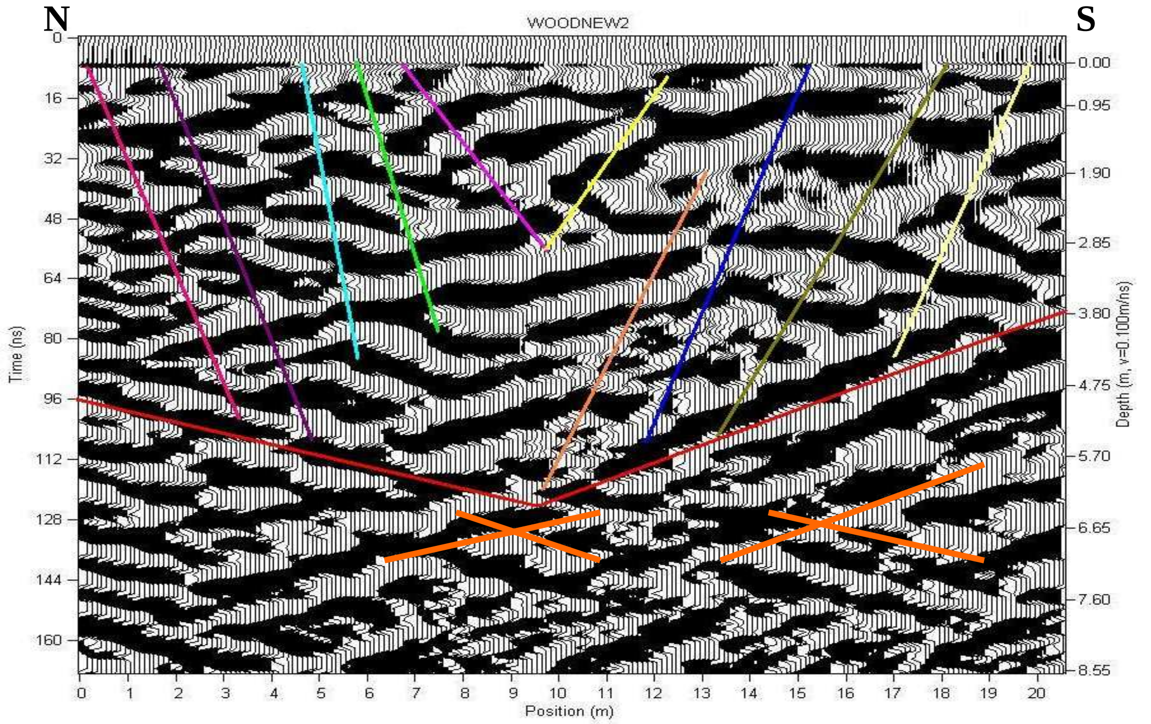


Figure J.4. WOODNEW2 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green, yellow, orange, royal blue, olive and cream lines denote offsets of beds. The bright orange ‘X’s’ outline crossovers observed in this transect.

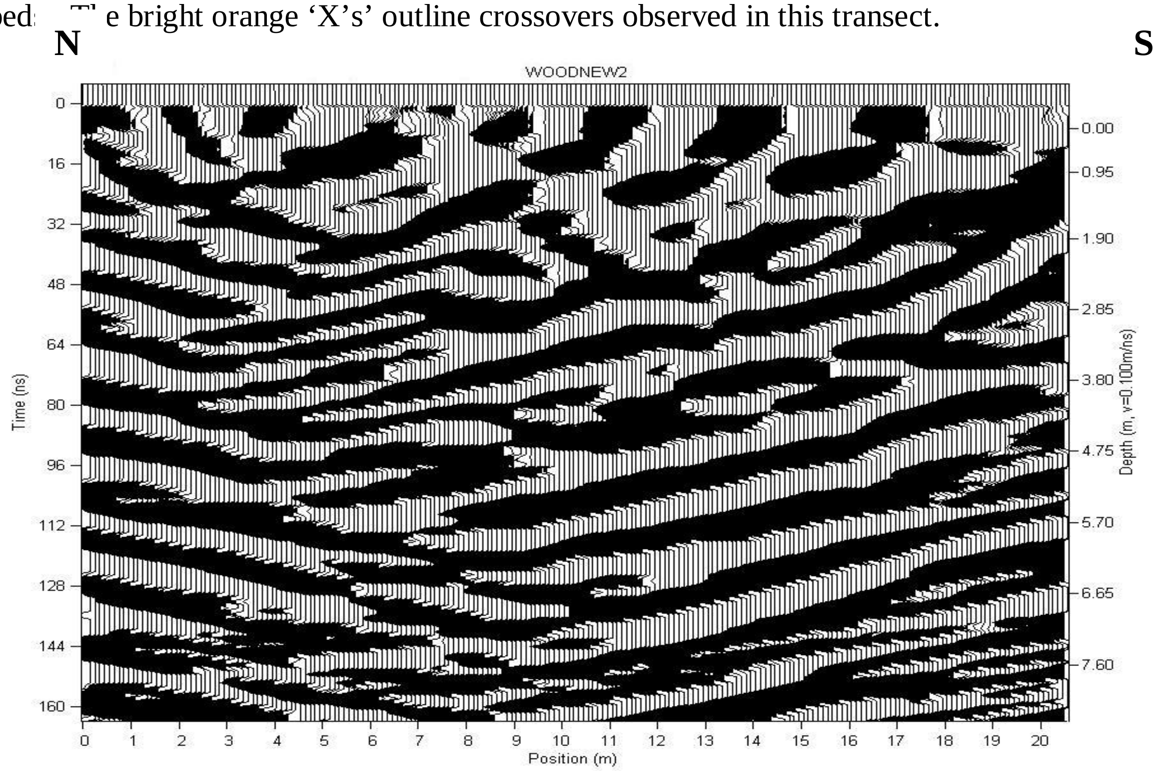


Figure J.5. WOODNEW2 Processed Data with two migration velocities (0.1 m/ns, 0.3 m/ns). The original ‘X’s’ observed in J.4 are no longer present.

J.3 Transect WOOD3_8

Transect WOOD3_8 is parallel to the west Band Room Wall, and between transects WOODNEW2 and WD2_L2F (Figure 6.10). The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to a TWTT of approximately 175 ns, or a depth of 8.75 m, using a velocity of 0.1 m/ns, the depth would be between 5.25 m and 6.13 m for soil velocities of 0.06 m/ns or 0.07 m/ns. Figure J.6 is a Wiggle Trace view of the raw WOOD3_8 transect data which shows the shallow reflectors to be relatively horizontal with a faint offset dipping towards the south. Figure J.7 is the same transect WOOD3_8, but is a processed Wiggle Trace view which shows several reflected features.

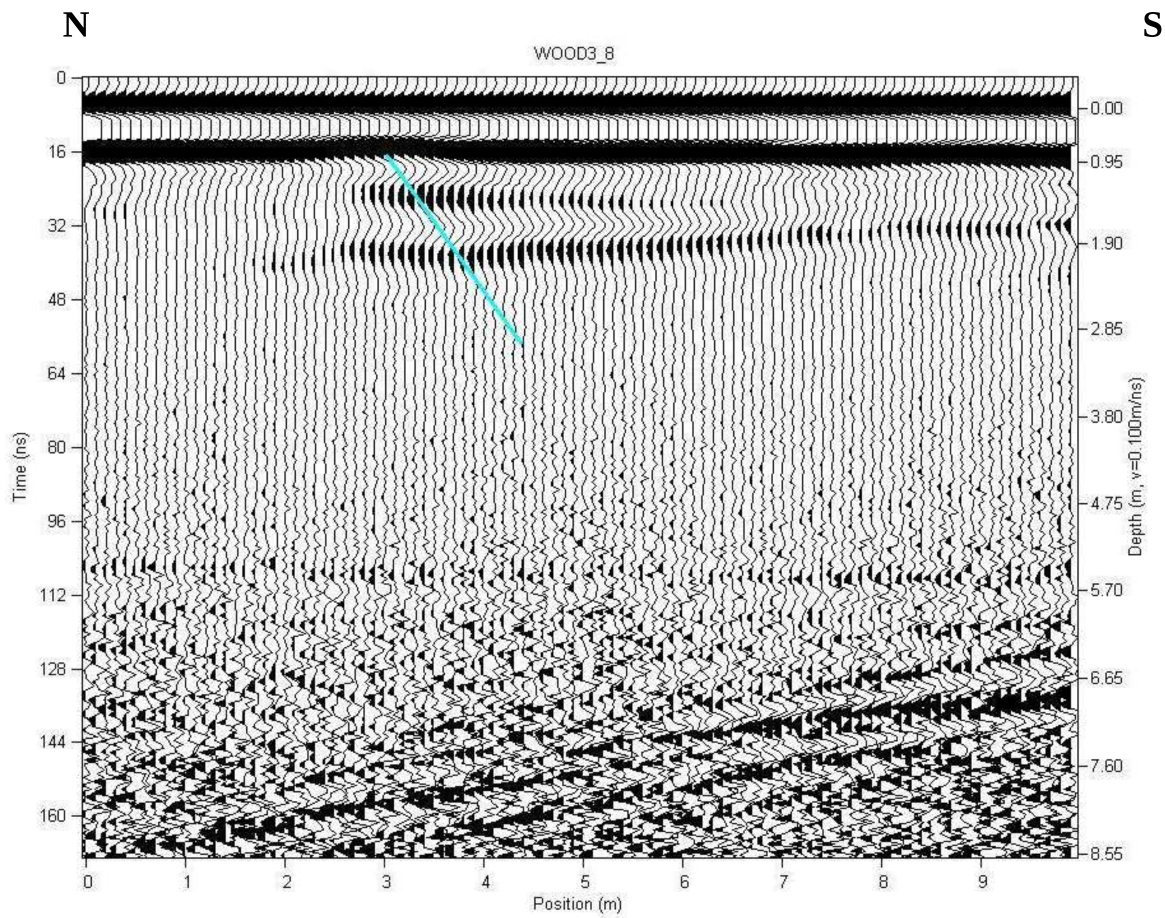


Figure J.6. WOOD3_8 Raw Data. The blue line denote an offset in bedding.

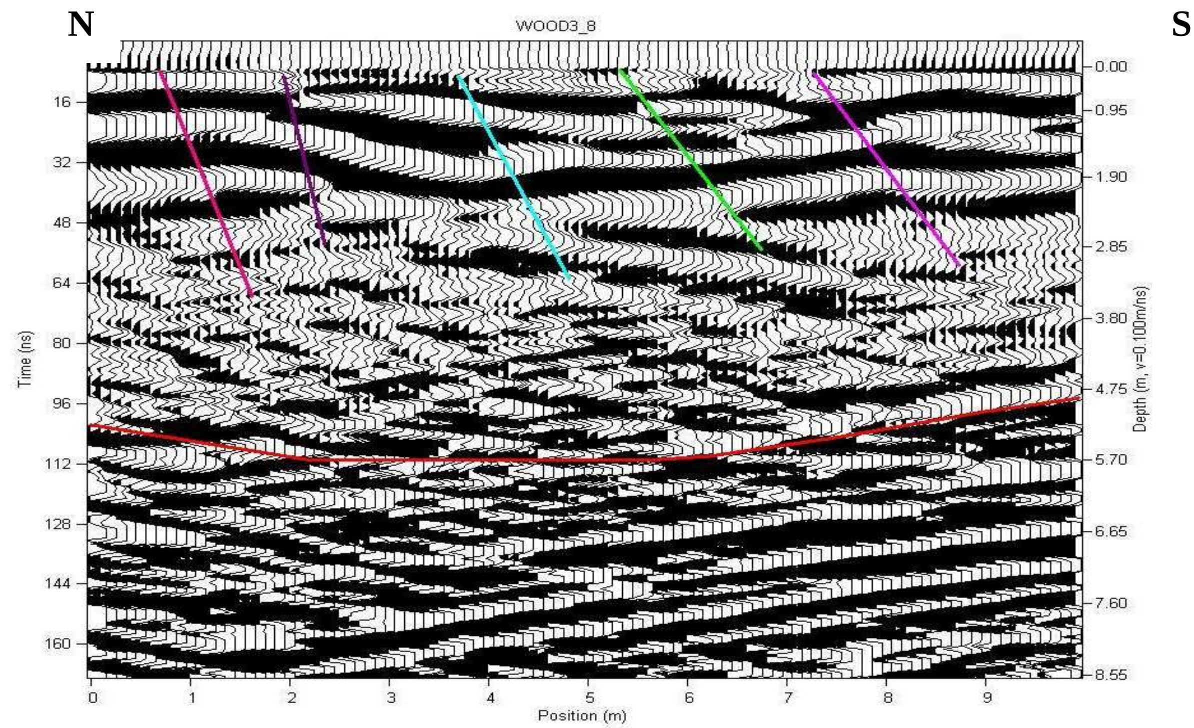


Figure J.7. WOOD3_8 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue and green lines denote offsets of beds.

There is one faint offset in bedding observed in the raw data from ground surface to a maximum TWTT of 48 ns or a depth of 2.4 m, and a horizontal distance of 3.5 m. This offset is outlined in Figure J.6 in blue. A bowl shaped feature is observed after processing that spans the entire length of the transect and is marked in Figure J.7 in red, at a maximum TWTT of 112 ns or a depth of 5.6 m. In addition there are four more shallow offsets observed in the processed data that are not seen in the raw data, two of these transects are located north and two south of the previously observed offsets in the raw data. The additional shallow offsets are located at horizontal distances of 1.5 m, 2.5 m, 6 m and 8 m, and are outlined in Figure J.7 in light pink, purple, green and purple pink respectively.

J.4 Transect WD2_L2F

Transect WD2_L2F is located outside and parallel to the west Band Room Wall, and between transects WOOD3_8 and WD2_L3F (Figure 6.10). The reflections shown in the

Ekko_View imaging program for this transect were received from ground surface to an approximate TWTT of 166.2 ns or a depth of 8.31 m, using a velocity of 0.1 m/ns, the depth would be between 4.99 m and 5.82 m for velocities of 0.06 m/ns or 0.07 m/ns. Figure J.8 is a Wiggle Trace view of the raw WD2_L2F transect data which shows very little reflected energy. Figure J.9 is the same transect WD2_L2F, but is a processed Wiggle Trace view which shows several reflected features.

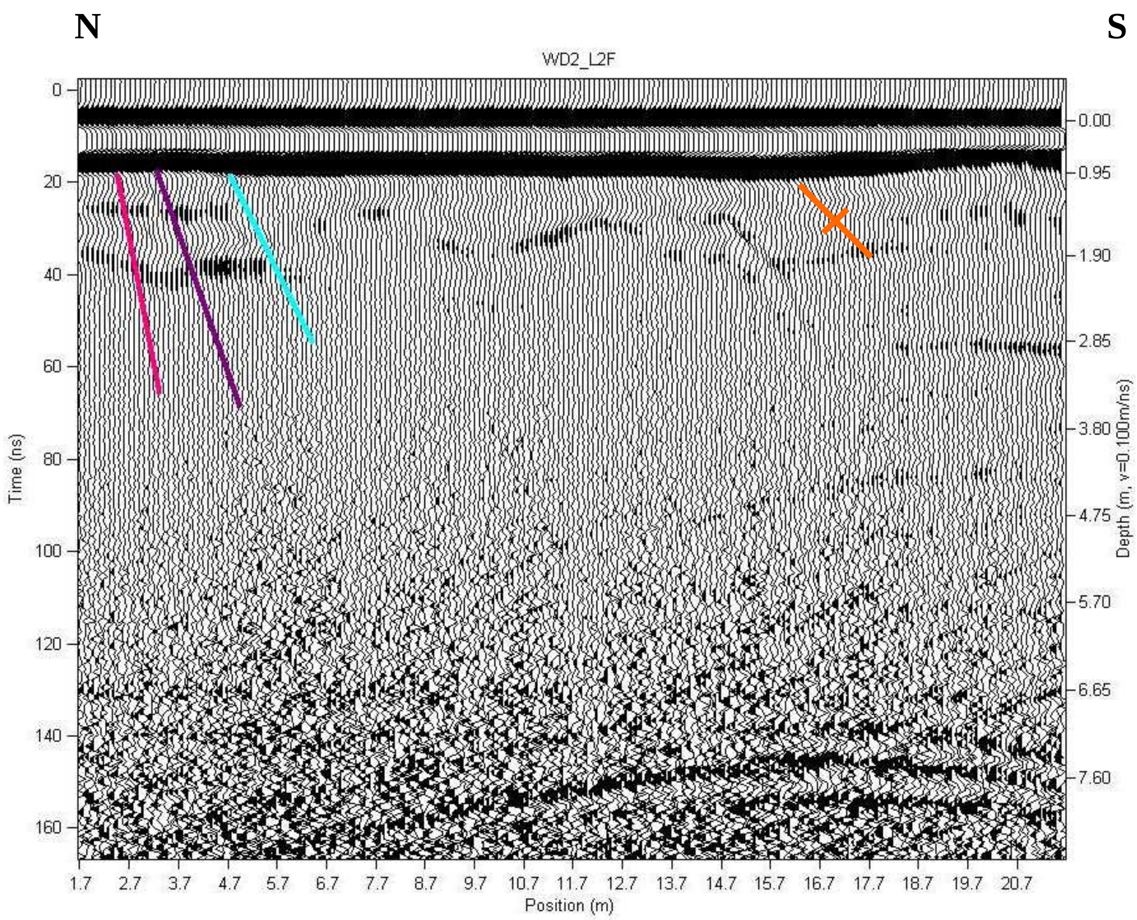


Figure J.8. WD2_L2F RAW data. The light pink, purple and blue lines denote offsets in bedding. The bright orange ‘X’ outlines a crossover observed in this transect.

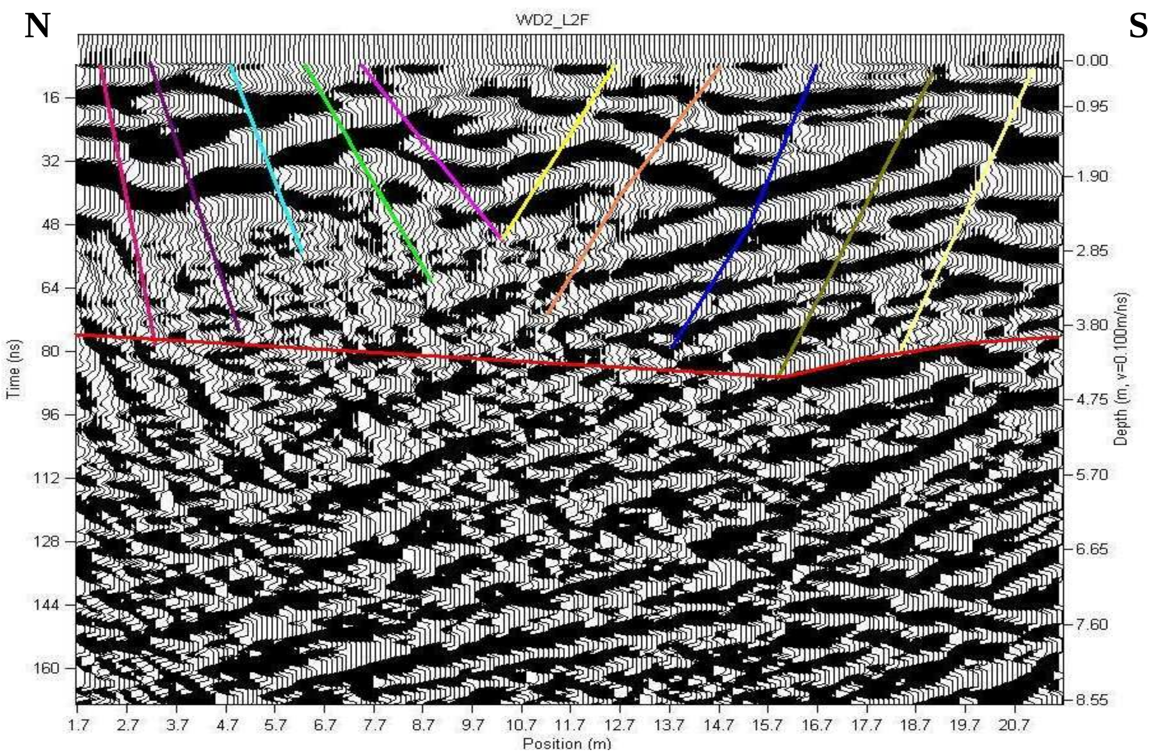


Figure J.9. WD2_L2F Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green, yellow, orange, royal blue, olive and cream lines denote offsets of beds.

There are three faint offsets in bedding observed at shallow depths from a minimum TWTT of 16 ns, or depth of 0.8 m, to a maximum TWTT of 96 ns, or a depth of 4.8 m. Each of these offsets are located at horizontal distances of 2.7 m, 4.2 m and 5.7 m and are outlined in Figure J.8 in light pink, purple and blue respectively. There is a crossover at a horizontal distance of 15.7 m, a TWTT of 40 ns and depth of 2 m, outlined with a bright orange 'X' in Figure J.8. After processing the bowl shaped feature is revealed as in previous transects and is marked in Figure J.9 in red, and has a maximum TWTT of 114.4 ns, or a depth of 5.72 m. There are seven more shallow offsets observed in the processed data that are not seen in the raw data, all seven are located south of those offsets observed in the raw data. The additional shallow offsets are located at horizontal distances of 7.7 m, 9.2 m, 11.2 m, 12.7 m, 15.7 m, 17.7 m and 19.7 m, and are outlined in Figure J.9 in green, purple pink, yellow, orange, royal blue, olive and cream respectively. Also, the 'X' crossover observed in the raw data was no longer present in the processed transect data, which means that migrating the data using the 0.1 m/ns for concrete/asphalt was accurate to remove this anomalous reflector.

J.5 Transect WD2_L3F

Transect WD2_L3F is the furthest west transect and is parallel to the west Band Room Wall, and west of WD2_L2F (Figure 6.10). The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to a TWTT of approximately 162.5 ns or a depth of 8.13 m, using a velocity of 0.1 m/ns, the depth would be between 4.88 m and 5.69 m for velocities of 0.06 m/ns or 0.07 m/ns. This transect once processed appears similar to the WD2_L2F transect. Figure J.10 is a Wiggle Trace view of the raw WD2_L3F transect data which shows very little reflected energy. Figure J.11 is the same transect WD2_L3F, but is a processed Wiggle Trace view which shows several reflected features.

Transect WD2_L3F contains six faint offsets in bedding observed at shallow depths from a minimum TWTT of 16 ns, or a depth of 0.8 m, to a maximum TWTT of 64 ns, or a depth of 3.28 m. Each of these offsets are located at horizontal distances of 4.2 m, 12.2 m, 12.7 m, 15.2 m, 18.7 m and 20.2 m and are outlined in Figure J.10 in purple, yellow, orange, royal blue, olive and cream respectively. As in the previous transects, a bowl shaped feature is observed spanning the entire length of the transect after processing and is marked in Figure J.11 in red, and has a maximum depth of 4.8 m or a TWTT of 96 m. There are three more shallow offsets observed in the processed not seen in the raw data, they are located in between offsets observed in the raw data. The additional shallow offsets are located at horizontal distances of 6.2 m, 7.7 m and 10.7 m, and are outlined in Figure J.11 in blue, green and purple pink respectively.

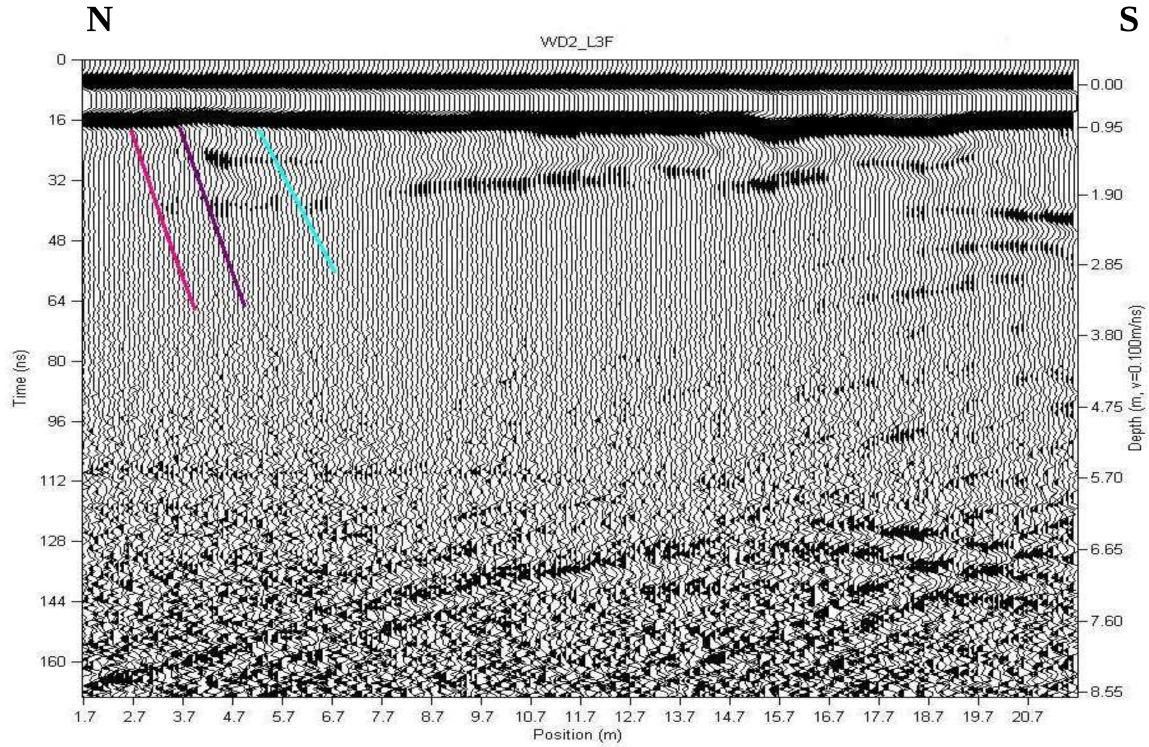


Figure J.10. WD2_L3F Raw Data. The purple, yellow, orange, royal blue, olive and cream lines denote offsets in bedding.

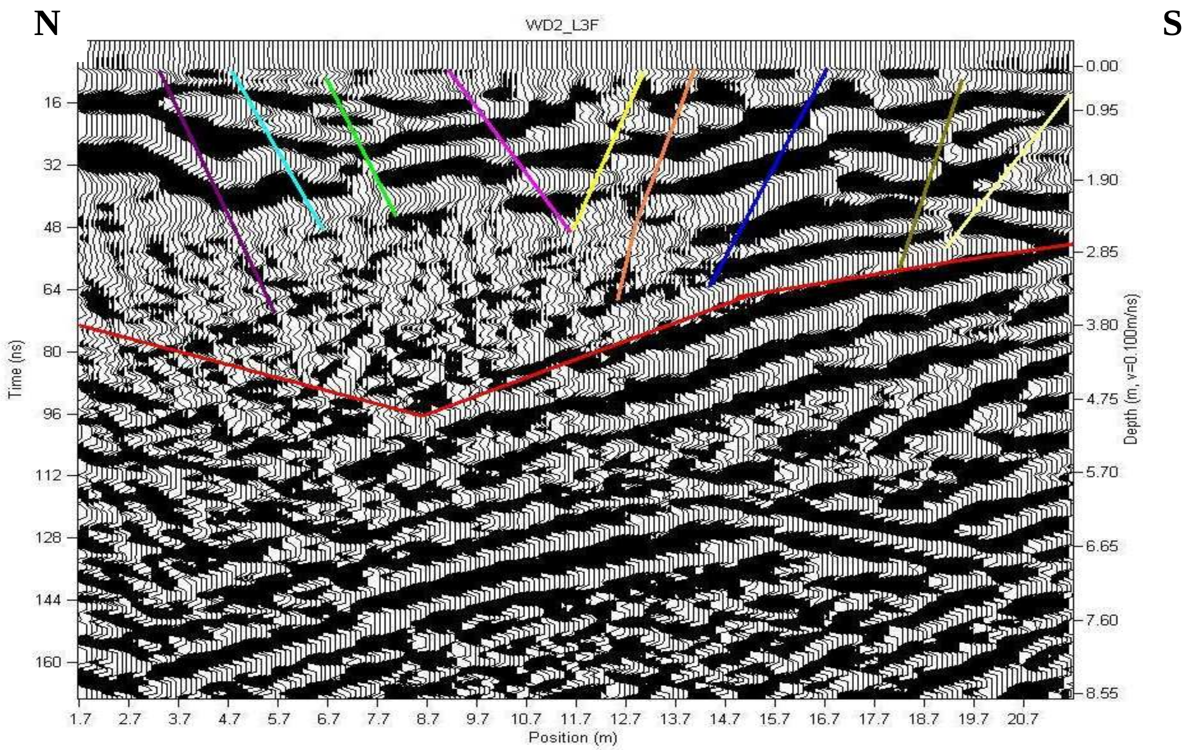


Figure J.11. WD2_L3F Processed Data. The red line is a bowl shaped feature; the purple, blue, green, purple pink, yellow, orange, royal blue, olive and cream lines denote offsets of beds.

J.6 Transect WOOD2_T3

Transect WOOD2_T3 is parallel to the southern Band Room Wall, at a 90^{o} angle to the red area transects, and is adjacent to the southern Band Room Wall (Figure 6.10). The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to an approximate TWTT of 96 ns, or a depth of 4.8 m, using a velocity of 0.1 m/ns, the depth would be between 2.88 m and 3.36 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure J.12 is a Wiggle Trace view of the raw WOOD2_T3 transect data which shows very little reflected energy and a shallow crossover with a maximum depth of 4.8 m. Figure J.13 is the same transect WOOD2_T3, but is a processed Wiggle Trace view which shows several reflected features and the same shallow crossover as observed in the raw data.

Transect WOOD2_T3 contains two faint offsets in bedding observed at shallow depths from a TWTT of 16 ns to a TWTT of 48 ns, or a depth of 0.8 m to 2.4 m, and a crossover. Each of these offsets are located at horizontal distances of 3.2 m and 4.7 m, the crossover at 6.2 m, and are outlined in Figure J.12 in yellow, purple pink and red respectively. After processing, the crossover observed in the raw data is still present and spans the entire length of the transect (red line in Figure J.13). There are three more offsets observed in the processed data, which are located east of the offsets observed in the raw data. These additional offsets are located at horizontal distances of 7.2 m, 8.2 m and 9.7 m, and are outlined in Figure J.13 in blue, green and purple respectively.

However, there are some angled reflectors, even the cross over feature that appears to be an artifact that is not a result of soil geology. According to literature, one suggestion to remove an affect such as the crossover is to migrate the data using the air wave velocity, 0.3 m/ns. Figure J.14 shows the WOOD2_T3 transect processed with both 0.1 m/ns and 0.3

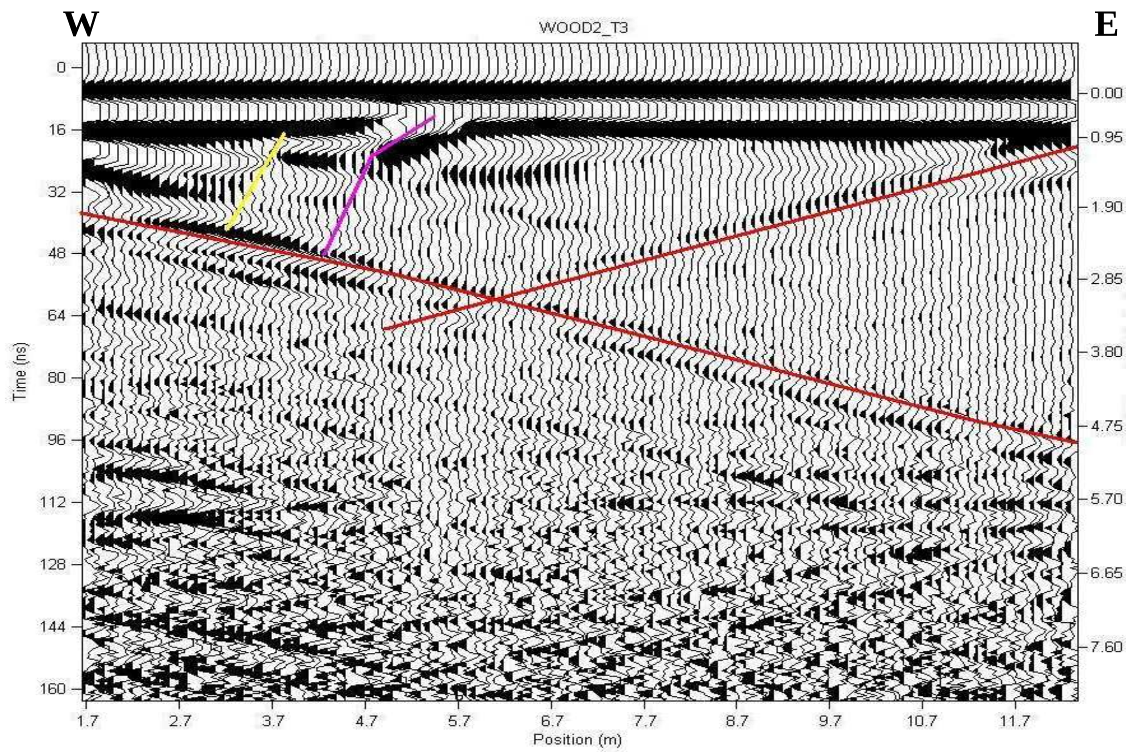


Figure J.12. WOOD2_T3 Raw Data. The red line is a portion of the crossover observed throughout the transects, the yellow and purple pink lines denote offsets of beds.

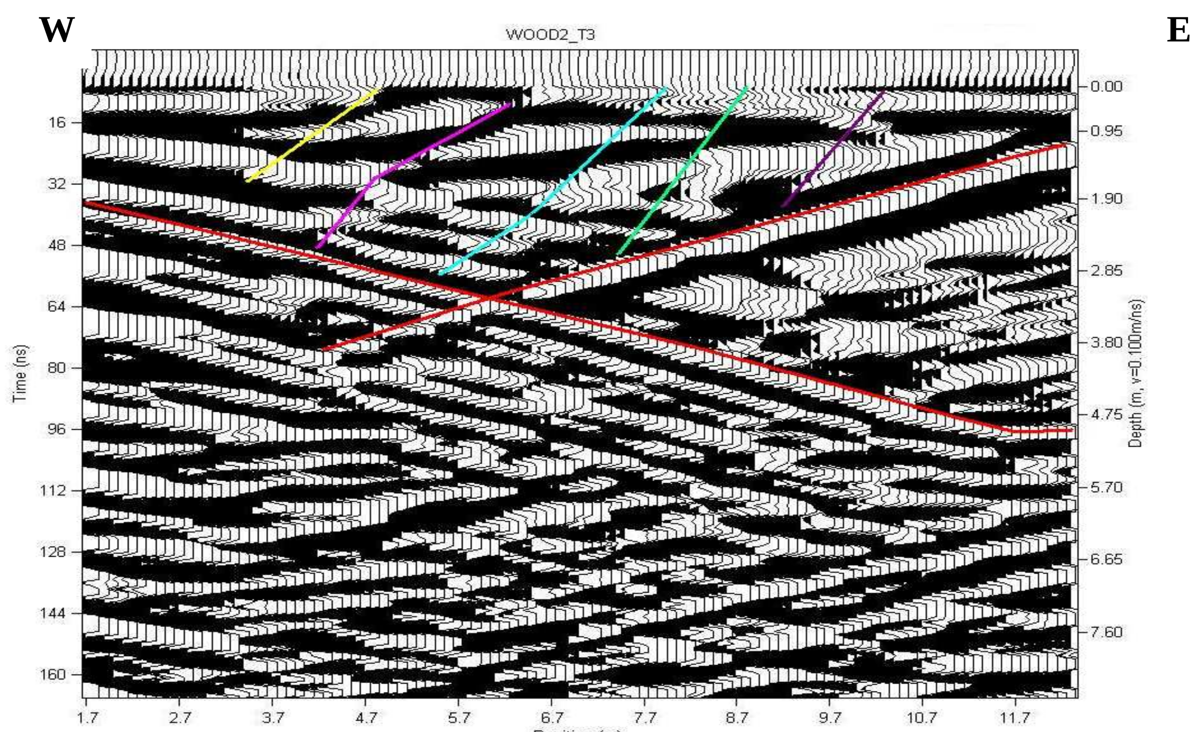


Figure J.13. WOOD2_T3 Processed Data. The red line is a portion of the crossover observed throughout the transects, the yellow, purple pink, blue, green and purple lines denote offsets of beds.

m/ns velocities. With the use of the additional 2-D Migration, the cross over feature appears to still be present, and the bulk of the data appears to be over migrated and concave upwards due to an incorrect velocity used.

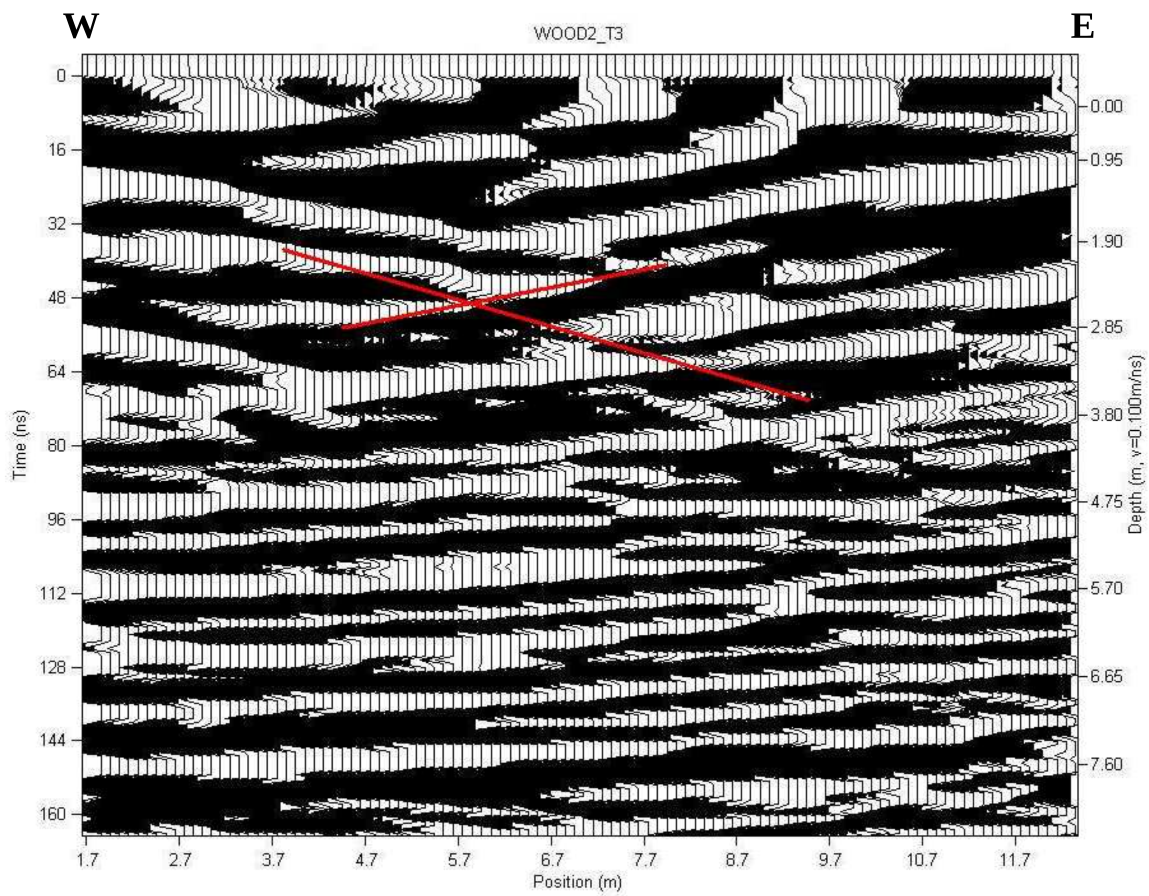


Figure J.14. WOOD2_T3 Processed Data with two migration velocities (0.1 m/ns, 0.3 m/ns). The red line again is a portion of the crossover observed throughout the processing of this transect.

J.7 Transect WD_T23R

Transect WD_T23R is parallel to the southern Band Room Wall; at a 90^{o} angle to the red area transects, and just south of the WD2_T13F/R transects (Figure 6.10). Prior to actual processing the transect data needed to be reversed so that the orientation of the traces were in the same direction as all other transects. The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to an approximate TWTT of 109.4 ns, or a depth of 5.47 m, using a velocity of 0.1 m/ns, the depth would be between 6.56 m and 7.66 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure J.15 is a Wiggle Trace view of the raw WD_T23R transect data which shows very little reflected energy, two faint offsets and three distinct crossovers. Figure J.16 is the same transect WD_T23R, but is a processed Wiggle Trace view which shows several offsets and the crossovers.

Transect WD_T23R contains two faint offsets in bedding observed at shallow depths from a TWTT of 16 ns to a TWTT of 48 ns, or a minimum depth of 0.8 m to a maximum depth of 2.4 m. These offsets are located at horizontal distances of 10.2 m and 8.2 m or 4.2 m and 6.2 m when compared to the other transects, and are outlined in Figure J.15 in yellow and purple pink respectively. Also, there is one main cross over feature that is located at a horizontal distance of 7.7 m (5.7 m if start position was 1.2 instead of 12.2 m), and is marked with a red ‘X’. Once the data has been processed both these offsets as well as additional ones are revealed. The same crossover observed in transects WOOD2_T3, WD2_T6F, and WD2_T13F/WD2_T13R; is clearly observed in the processed data. The main crossover spans the entire length of the transect, has a maximum TWTT of 112 ns or a depth of 5.6 m, and is marked in Figure J.16 in red. There are three more shallow offsets observed in the processed data. They are to the east of the offsets observed in the raw data. The additional shallow offsets are located at horizontal distances of 7.2 m, 5.7 m, and 4.2 m, and are outlined in Figure J.16 in blue, green and purple respectively.

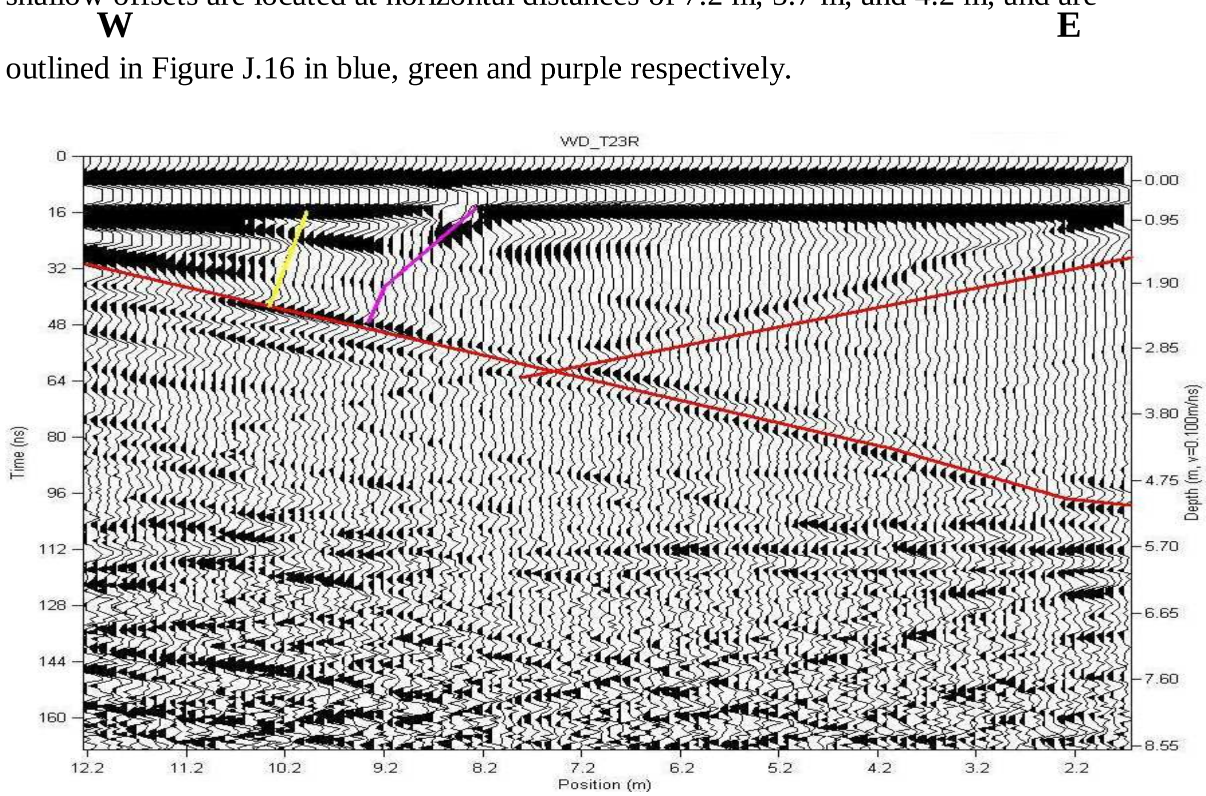


Figure J.15. WD_T23R Raw Data. The red line is a portion of the crossover observed throughout the transects, the yellow and purple pink lines denote offsets of beds.

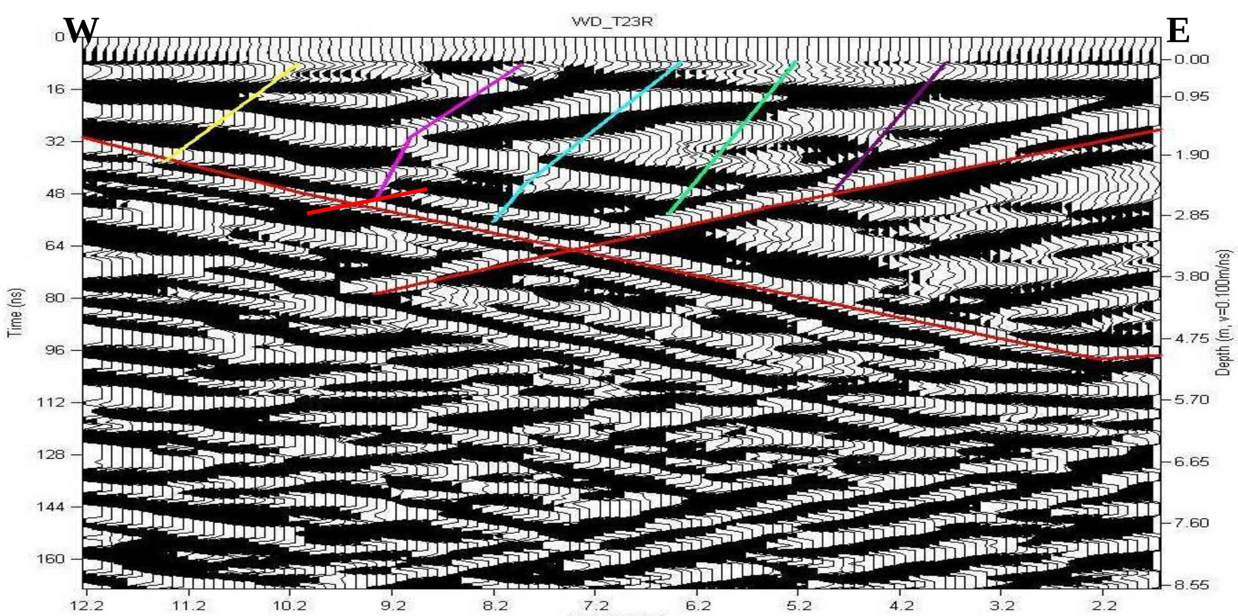


Figure J.16. WD_T23R Processed Data. The red line is a portion of the crossover observed throughout the transects, the yellow, purple pink, blue, green and purple lines denote offsets of beds.

However, there are some angled reflectors, such as the crossover observed that appears to be an artifact that is not a result of soil geology. I tried to eliminate the crossover by migrating the data using the air wave velocity, 0.3 m/ns. Figure J.17 shows the WD_T23R transect processed with both 0.1 m/ns and 0.3 m/ns velocities. With the use of the additional 2-D Migration, the cross over feature is still present and the bulk of the data appears to be over migrated due to an incorrect velocity used.

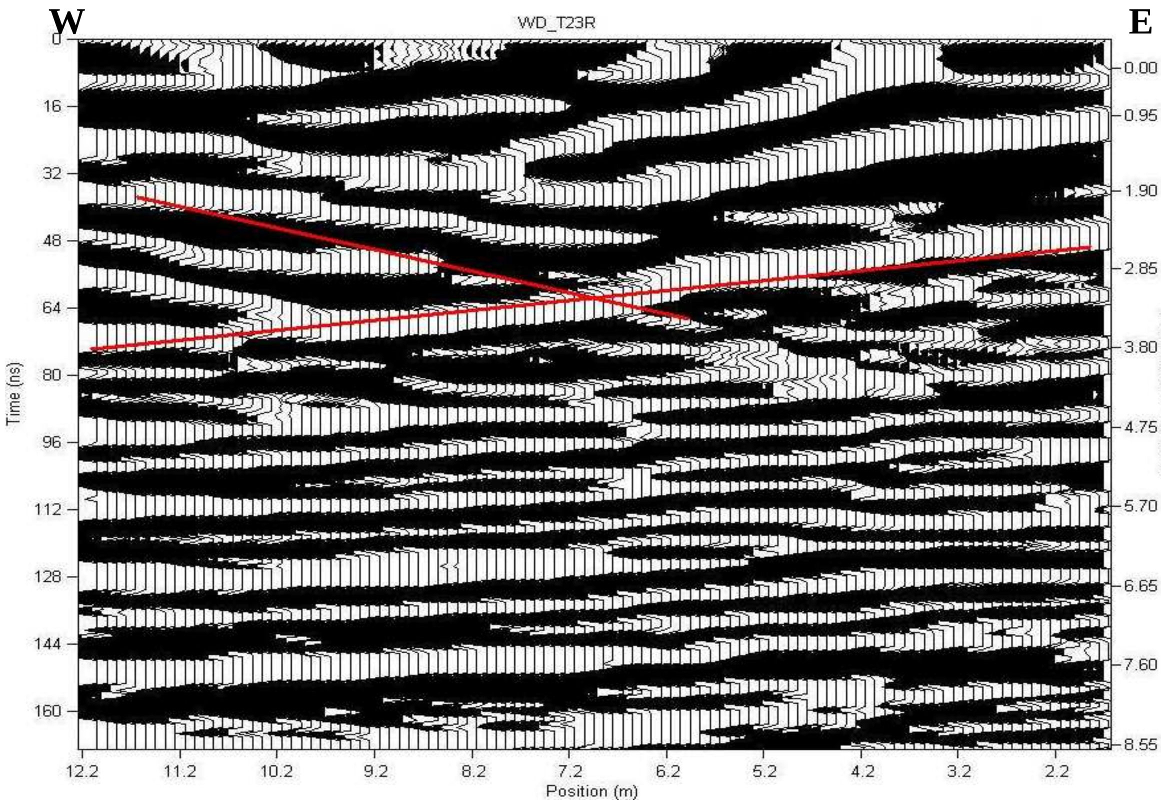


Figure J.17. WD_T23R Processed Data with two migration velocities (0.1 m/ns, 0.3 m/ns). The red line again is a portion of the crossover observed throughout the processing of this transect.

J.8 Transect WAYWALK2

Transect WAYWALK2 is located outside on the eastern side of the Auditorium (Figure 6.10). The reflections observed were received from ground surface to a TWTT of approximately 304 ns, or a depth of 15.2 m, using a velocity of 0.1 m/ns, the depth would be between 9.12 m and 10.64 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure J.18 is a

Wiggle Trace view of the raw WAYWALK2 transect data which shows relatively horizontal reflectors at shallow depths, from ground surface to a TWTT of 80 ns or a depth of 4.0 m, and two bedding offsets dipping towards the south. Figure J.19 is the processed transect WAYWALK2, which shows a bowl shaped feature and four additional offsets dipping towards the south.

Transect WAYWALK2 contains two faint offsets in bedding observed at shallow depths, from ground surface to an approximate TWTT of 80 ns or a depth of 4.0 m bgs, and at horizontal distances of 2.5 m and 3.5 m. These two offsets are outlined in Figures J.18 and J.19 in blue and green respectively. The same bowl shaped feature observed in transect WAYWALK1, is also observed in the processed WAYWALK2 and spans the entire length of the transect, starting at an approximate TWTT of 48 ns, or a depth of 2.4 m, to a maximum TWTT of 80 ns, or a depth of 4.0 m, and is marked in Figure J.19 in red. There are four more shallow offsets observed in the processed data. Two are located north and two are south of the offsets observed in the raw data. These additional shallow offsets are located at horizontal distances of 0.5 m, 1.5 m, 5 m and 6 m, and are outlined in Figure J.19 in light pink, purple, purple pink and yellow respectively.

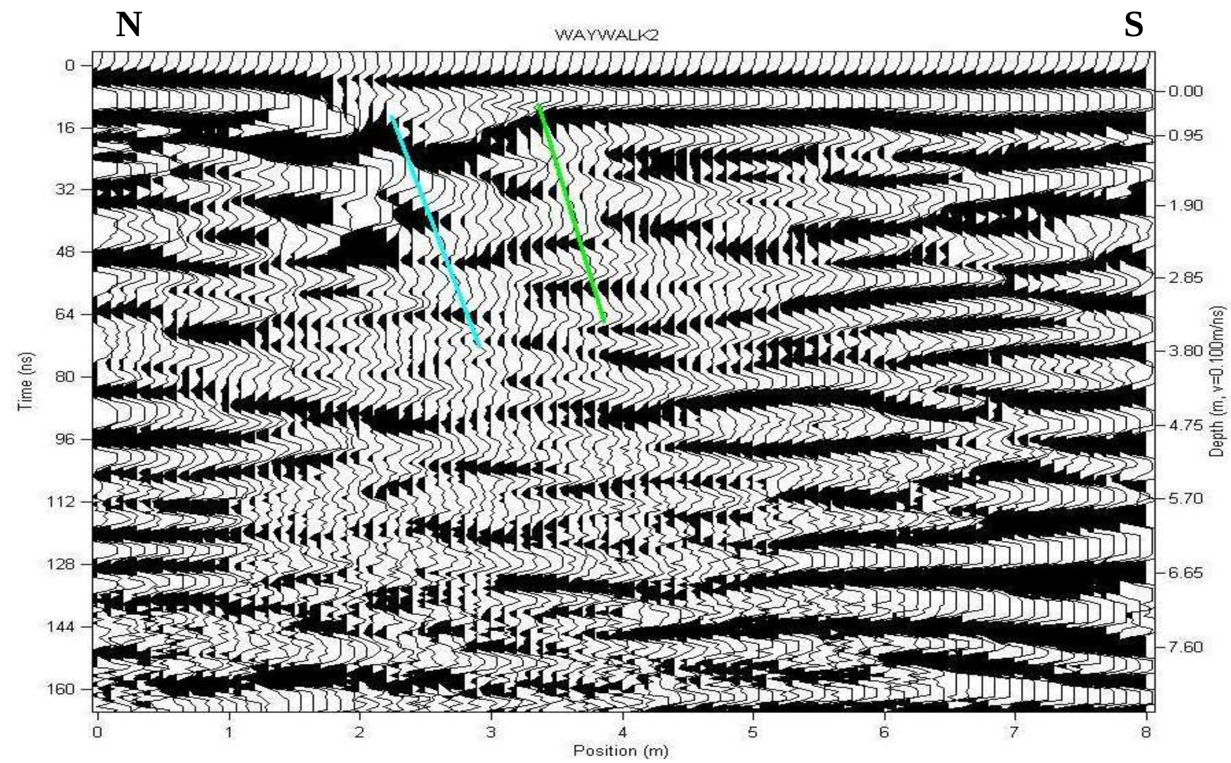


Figure J.18. WAYWALK2 Raw Data. The blue and green lines denote offsets of beds.

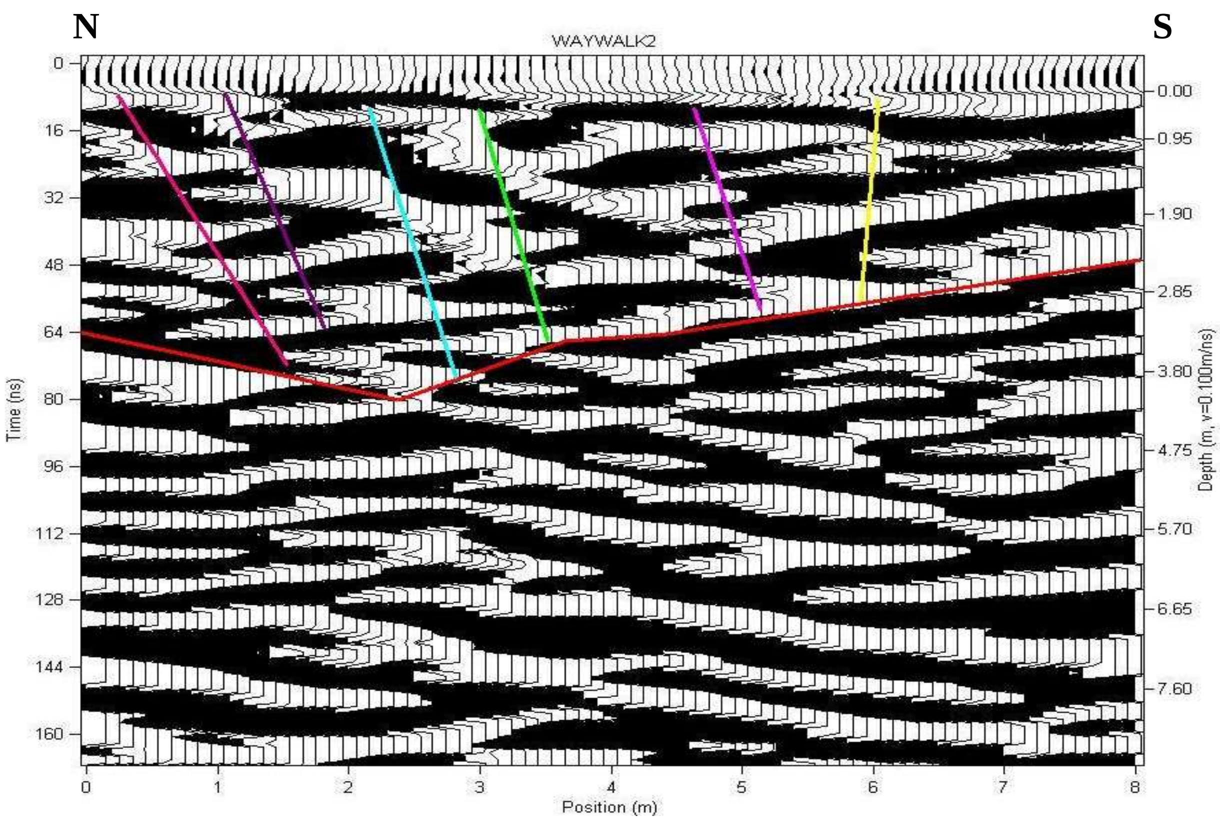


Figure J.19. WAYWALK2 Processed Data. The red line is a bowl shaped feature, the two pinks; purple, blue, green and yellow denote offsets of beds.

APPENDIX K GPR RESULTS FOR REMAINING GLEN OAKS HIGH SCHOOL TRANSECTS

K.1 Transect Walkway1 (WLKWY 1), East of Building H

Transect WLKWY1 is located in the middle of the interior covered walkway, and between WLKWY2 and WLKWY3 (Figure 6.40). The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to a TWTT of 322 ns , or a depth of 16.1 m, using a velocity of 0.1 m/ns, the depth would be between 9.66 m and 11.27 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure K.1 is a Wiggle Trace view of the raw WLKWY1 transect which shows relatively horizontal reflectors from ground surface to approximately 322 ns, and at least one bedding offset dipping towards the north. Figure K.2 is the same transect WLKWY1, but is a processed Wiggle Trace view which shows three bedding offsets dipping towards the south and the one seen in the raw data again dipping towards the north.

There are three faint offsets in bedding observed in the raw data at shallow depths from a TWTT of 16 ns to 114.4 ns, or a minimum depth of 0.8 m to a maximum depth of 5.72 m, and at horizontal distances of 5.5 m, 7.0 m and 8.0 m in Figure K.1 in pink, blue and green respectively. There are two additional shallow offsets observed in the processed data located north of the offsets observed in the raw data. These additional shallow offsets are observed at a maximum TWTT of 160 ns, or a depth of 8 m, and are located at horizontal distances of 3.0 m and 3.5 m in Figure K.2 in yellow and purple respectively.

K.2 Transect Walkway2 (WLKWY 2), East of Building H

Transect WLKWY2 is located on the western side of the interior covered walkway, and to the west of WLKWY1 and closest to the former Building H on the eastern side (Figure 6.40).

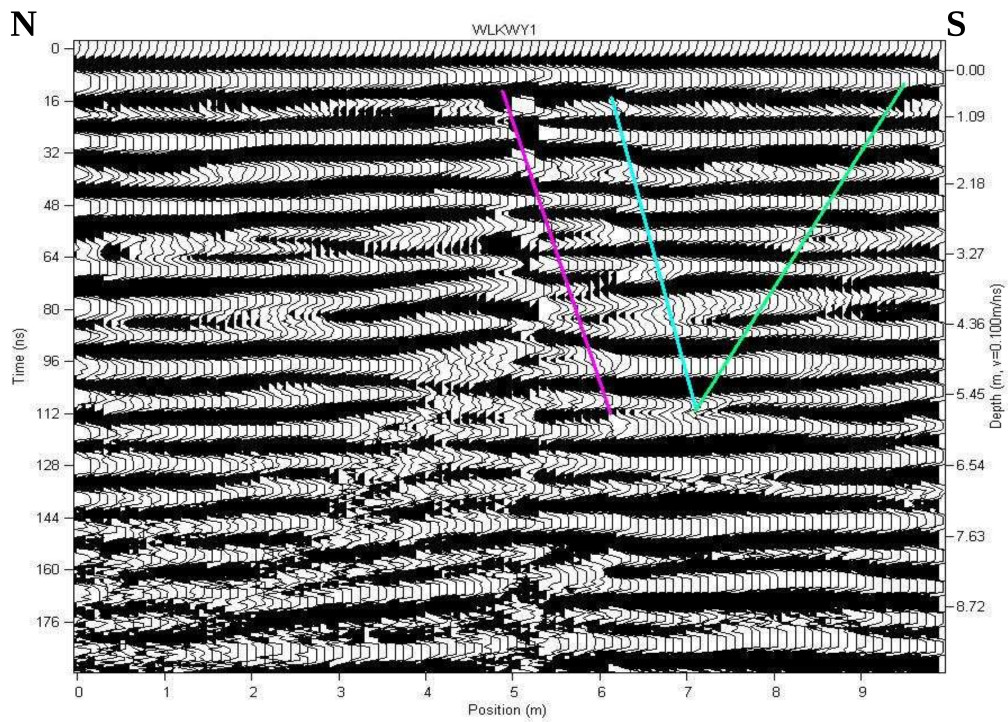


Figure K.1. WLKWY1 Raw Data. The pink, blue and green lines denote offsets of beds.

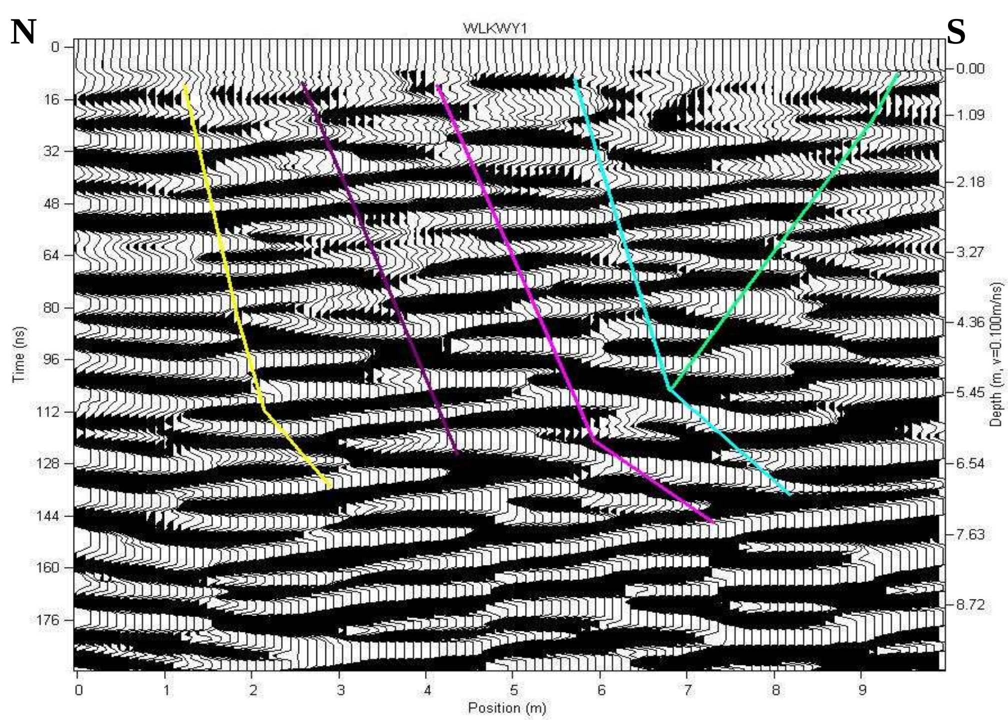


Figure K.2. WLKWY1 Processed Data. The yellow, purple, pink, blue and green lines denote offsets of beds.

The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to a TWTT of 178.8 ns, or a depth of 8.94 m, using a velocity of 0.1 m/ns, the depth would be between 5.36 m and 6.26 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure K.3 is a Wiggle Trace view of the raw WLKWY2 transect data which shows relatively horizontal reflectors and three faint offsets in bedding. Figure K.4 is the same transect WLKWY2, but is a processed Wiggle Trace view which shows five offsets in bedding.

There are three faint offsets in bedding observed in the raw data at shallow depths from a minimum TWTT of 16 ns to maximum 80 ns, or a depth of 0.8 m to a maximum of 4 m, and at horizontal distances of 2 m, 4.5 and 5.5 m in Figure K.3 in yellow, pink and blue respectively. There are two additional offsets observed in the processed data. They are between the offsets observed in the raw data. These additional offsets are located at horizontal distances of 3.5 m and 7 m in purple and green respectively in Figure K.4, and the maximum depth of penetration for all bedding offsets in the processed data is 114.4 ns, or 5.72 m.

K.3 Transect Outside Walkway (OSWLKWY1), West of former Building H

Transect OSWLKWY1 is the outside walkway, located between the driveway and the western side of the former Building H (Figure 6.40). The reflections shown in the Ekko_View imaging program for this transect were received from ground surface to a TWTT of 256 ns, or a depth of 12.8 m, using a velocity of 0.1 m/ns, the depth would be between 7.68 m and 8.96 m for a velocity of 0.06 m/ns or 0.07 m/ns. Figure K.5 is a Wiggle Trace view of the raw OSWLKWY1 transect data which shows relatively horizontal reflectors and two faint offsets dipping southward. Figure K.6 is the same transect OSWLKWY1, but is a processed Wiggle Trace view which shows four offsets in bedding dipping southward.

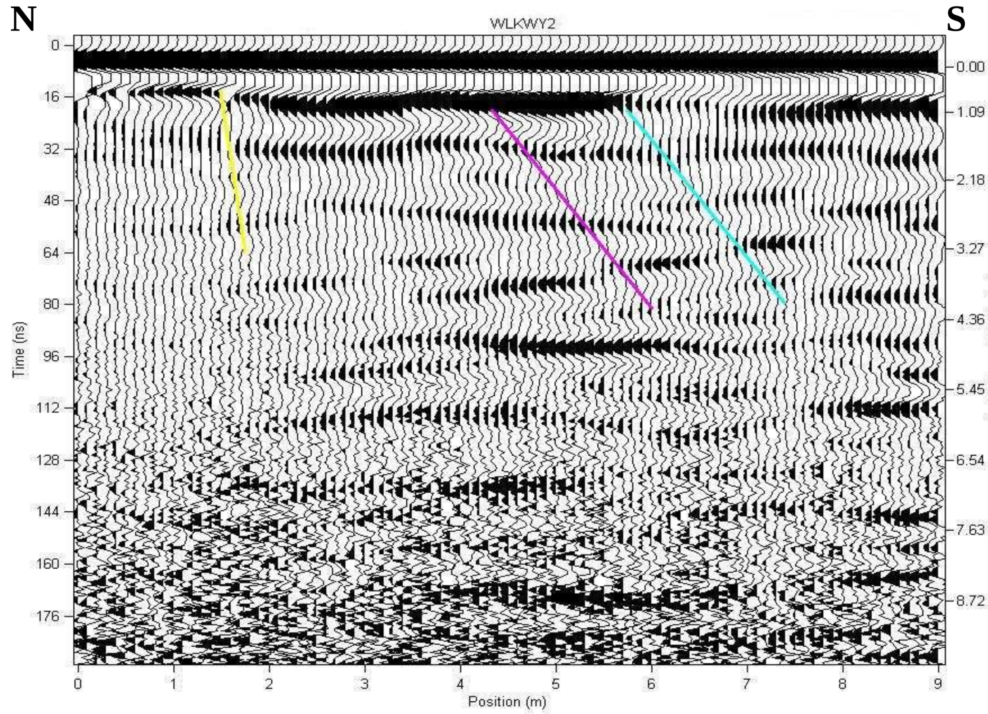


Figure K.3. WLKWY2 Raw Data. The yellow, pink and blue lines denote offsets of beds.

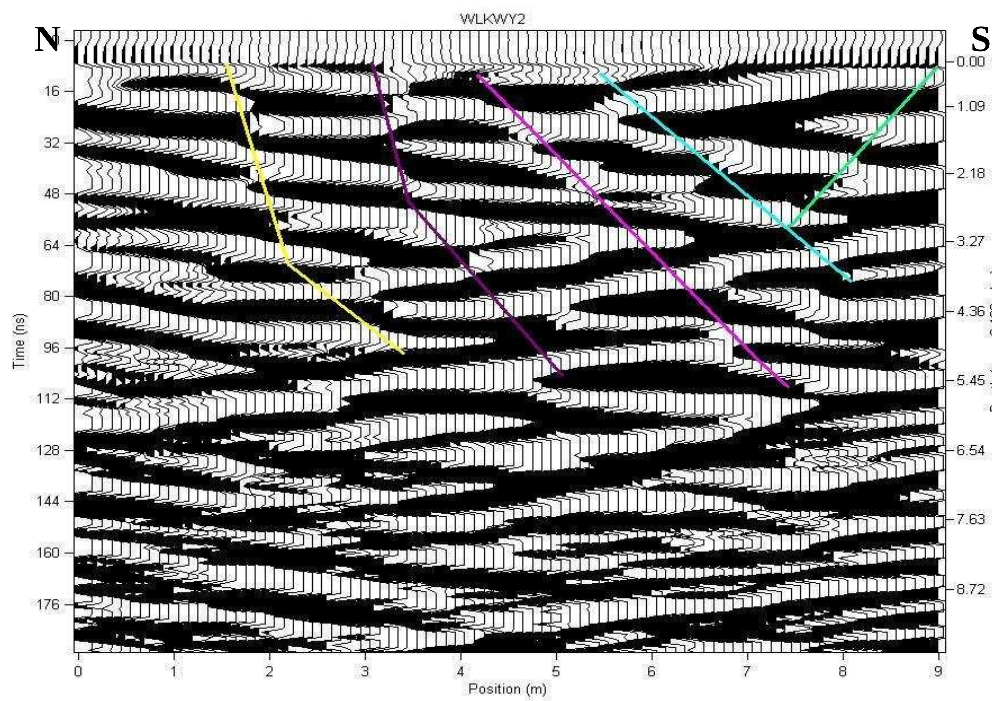


Figure K.4. WLKWY2 Processed Data. The yellow, purple, pink, blue and green lines denote offsets of beds.

There are two faint offsets in bedding observed in the raw data at shallow depths from a minimum TWTT of 16 ns to a maximum of 80 ns, or a depth of 0.8 m to a maximum of 4 m, and at horizontal distances of 19.5 m and 27 m in yellow and blue respectively (Figure K.5). There are two additional offsets observed in the processed data. In between the offsets observed in the raw data. These additional offsets are located at horizontal distances of 22 m and 24.5 m in purple and pink respectively in Figure K.6, and the maximum depth of penetration for all bedding offsets in the processed data is 128.7 ns, or 6.44 m.

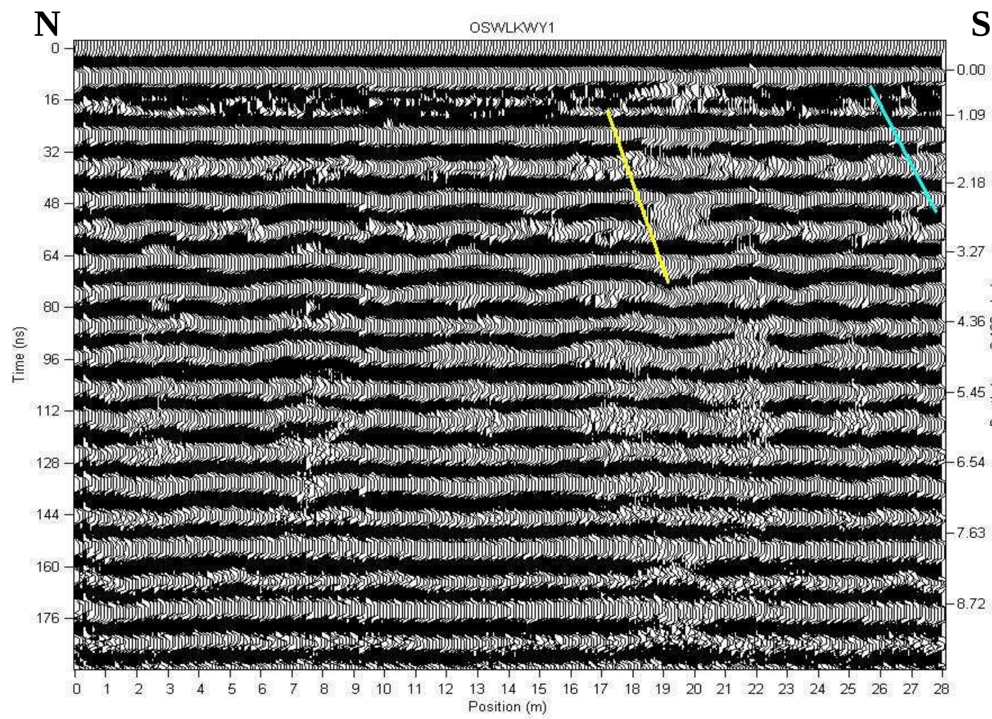


Figure K.5. OSWLKWY1 Raw Data. The yellow and blue lines denote offsets of beds.

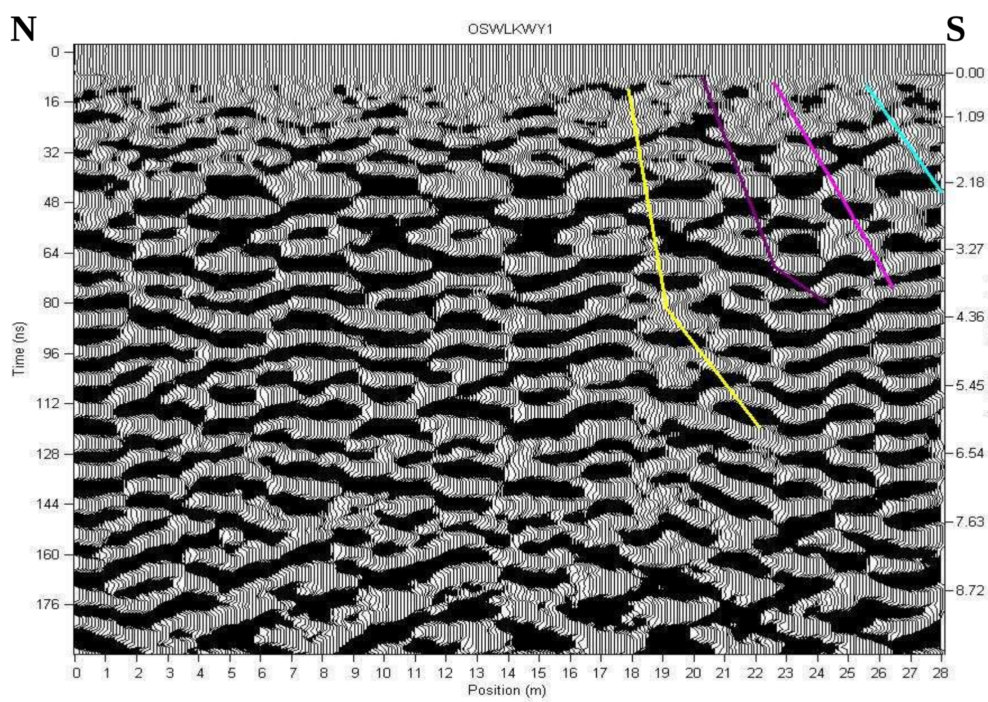


Figure K.6. OSWLKWY1 Processed Data. The yellow, purple, pink and blue lines denote offsets of beds.

VITA

Angela Sue Mooi Thomas was born on September 16, 1974, to Teresa and Kevin Mooi, at St. Mary's Hospital in Kentwood, Michigan. She was raised in Kentwood, Michigan. Her parents divorced when she was 5 ½ years old, her father was remarried to Sandy Hankamp and together they raised Angela. Angela lived in Michigan, where she attended Brookwood elementary and Valley Wood Middle school until 7th grade. After 7nth grade, Angela then moved with her father, stepmother and sister, Cathy Mooi, to Augusta, Georgia, where she completed her 8th grade year of school before moving to Hoover, Alabama. She then went to W.A. Berry High School in Hoover, Alabama.

She graduated from W.A. Berry High School in May 1992. Angela then attended University of Alabama in Tuscaloosa, Alabama, to pursue a Bachelor of Science degree in geology which she received in August 1997. She then proceeded to a career in the engineering and environmental consulting profession.

She started her professional career as a Geologist with ENSR Consulting & Engineering in Norcross, Georgia. She was with ENSR for a period of approximately ten months, from April 1998 to February 1999. During her employment she acted as a Staff Specialist with responsibilities that included compliance with ASTM standards for field inspections, researching government regulatory agency data, performing historical data reviews and deed searches, evaluation of site topographic, hydrologic, and geologic features, and identifying potential past and or present environmental concerns related to the subject property or surrounding properties. During her time at ENSR, Angela married Roy Eugene Thomas on September 12, 1998. After her time at ENSR she left to join a company that would allow her to do more subsurface and complex environmental work, as well as use more aspects of her Geology degree.

From March 1999 to January 2000 she was employed with Delta Environmental Consultants in Norcross, Georgia. During her employment she acted as a Staff Geologist with responsibilities that included Phase II Environmental Site Assessments, borehole logging, rock core logging, and organic vapor screening and collecting soil and groundwater samples during Geoprobe™ investigations and monitoring well installation activities. She acted as the site manager for a HSRA project which included such responsibilities as, supervision and installation of monitoring wells using Rotasonic, air/mud rotary, hollow-stem auger and HQ rock core drilling techniques. She was also a site manger for the delineation of a free-phase LNAPL/DNAPL (creosote) plume using a CPT mounted on a LIF/ROST. Lastly, she conducted regulatory compliance sampling, operations and maintenance of a DNAPL recovery system for chlorinateds, reporting for industrial and manufacturing clientele including RCRA facilities, HSRA projects and a former manufactured gas plant that was under voluntary clean-up. After her eleven months of employment, she left Delta to move with her husband to New Orleans, Louisiana.

From January 2000 to January 2001 she was employed with CH2M HILL in New Orleans, Louisiana. During her employment she acted as a Staff Geologist with responsibilities that include working on a project conducting Risk Investigation activities for an EPA Superfund site, in Alexandria Louisiana, under the RAC6 contract. During these field activities she collected soil/groundwater, plant/terrestrial invertebrates, and surface water/sediment samples. On this site they conducted Geoprobe™ and hollow-stem auger drilling investigations, and logged the boreholes using the USCS terminology, and also she supervised the installation of monitoring wells. During this project she was in charge of sample tracking using Microsoft Access, she prepared technical activities work plans, field sampling plans, site management plans, health and safety plans, technical memos and Quality Assurance Project Plans. After her year and 1 month employment, she left CH2M HILL to join a company that would allow her to do more fieldwork, broaden her knowledge of fieldwork techniques, Geology and management of large-scale projects.

From January 2001 to August 2003 she was employed with URS Corporation in Baton Rouge, Louisiana. During her employment she acted as a Senior Staff Geologist where she was put in charge of one major oil refinery client concerning all fieldwork, reporting, and general project management responsibilities. She was the site manager for this oil refinery's environmental drilling project which included both supervision and installation of 32 monitoring wells using both Rotasonic and hollow-stem auger drilling techniques. She also performed the related well development, quarterly groundwater sampling, and soil sampling during investigation and borehole logging. Additionally, she was the site manager on multiple smaller Geoprobe™ investigation projects, collected soil/groundwater samples and logged the borings. She performed the interpretation and presented the resulting data report to both the client and regulatory agencies. She developed all geologic cross-sections of near surface stratigraphy with an emphasis on the understanding and evaluating potential constituent migration pathways on all projects assigned. She also assisted in plume delineation and concentration trend analyses. Additionally, she took care of all her own scope/costing, work plans, and health and safety plans for her projects. She then proceeded to graduate school to pursue her Master of Science degree in geology at LSU in August 2003.

During Angela's time at LSU she gave birth to her first baby girl on May 24, 2004, to Abigail Jordan Thomas. Also, Angela accepted an internship for fall 2004 during graduate school with Shell Oil in New Orleans, Louisiana. Angela hopes to attain permanent employment with the oil and gas industry after graduation.